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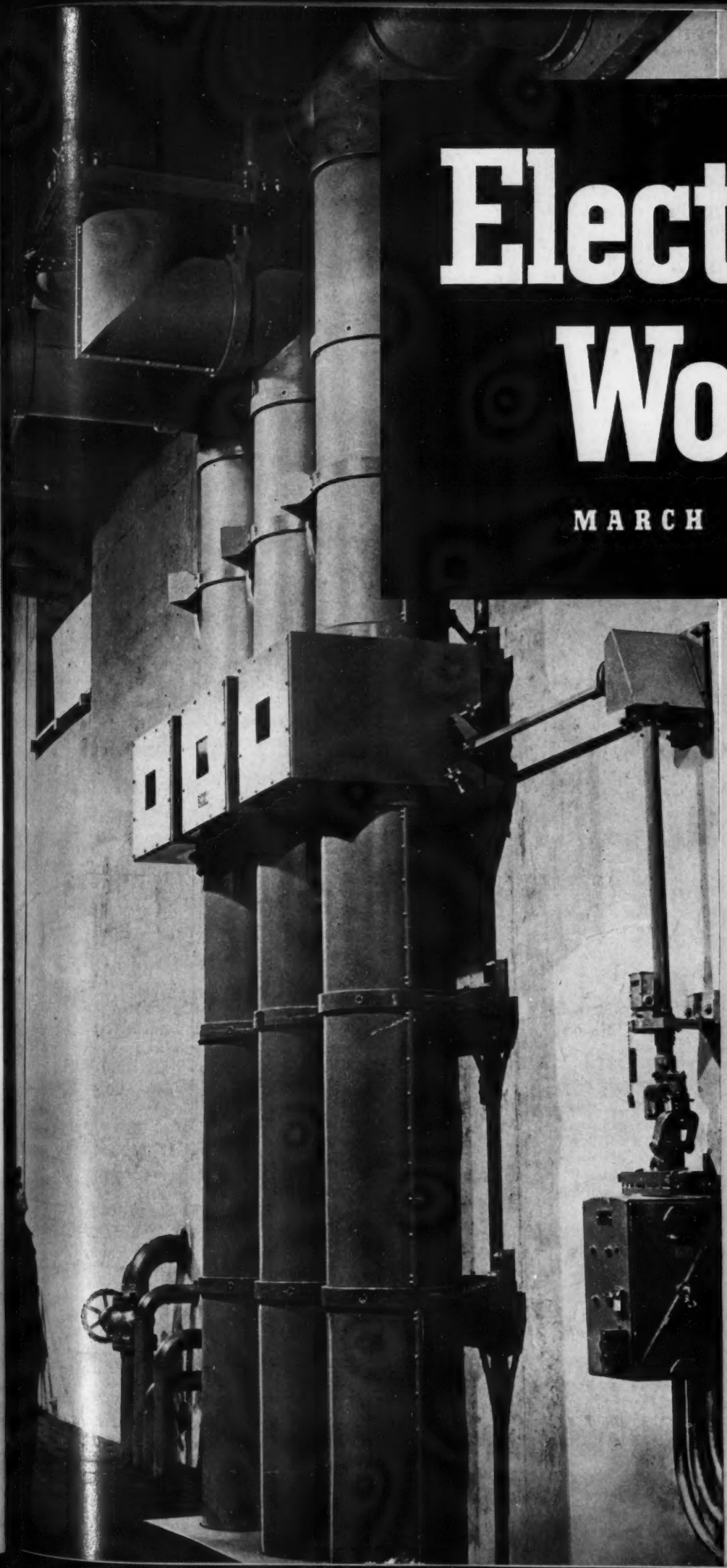
Electrical World

MARCH 30, 1946



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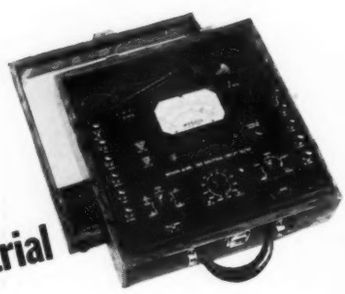

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Contents

Isolated Phase Bus Experience Dominantly Favorable..... 44

"Snow Buggy" for Line Repairs on Continental Divide..... 48
G. C. FARNSWORTH, Public Service Co. of Colorado

Hay Drier a Profit Maker for Both Farmer and Utility..... 50
CARL JERRINGS, Rochester (N. Y.) Gas & Electric Co.

Desirable Design Features for Voltage Regulators..... 52
JAMES A. RAWLS, Virginia Electric & Power Co.

Quick Guide to Rural Voltage Drops..... 55
H. N. MULLER, JR. and D. L. WHITEHEAD, Westinghouse Electric Corp.

Navy Put Diesel Plant in Underground Chamber..... 58
CAPTAIN M. S. FITZWILLIAM, U. S. Navy

SPA Hydro Program—Summary and Fallacies..... 60

Editorials.....43 and 64

Washington Comment..... 66

News of the Week..... 67

HOW..... 75

Engineering Reference Sheets.....86, 88 and 90

Load Building..... 94

New Equipment..... 98

News About People..... 111

Manufacturing and Markets..... 118

Sales Opportunities..... 126

Recent Rate Changes..... 128

Recent Legislation..... 129

Book Reviews..... 131

Index of Advertisements..... 134

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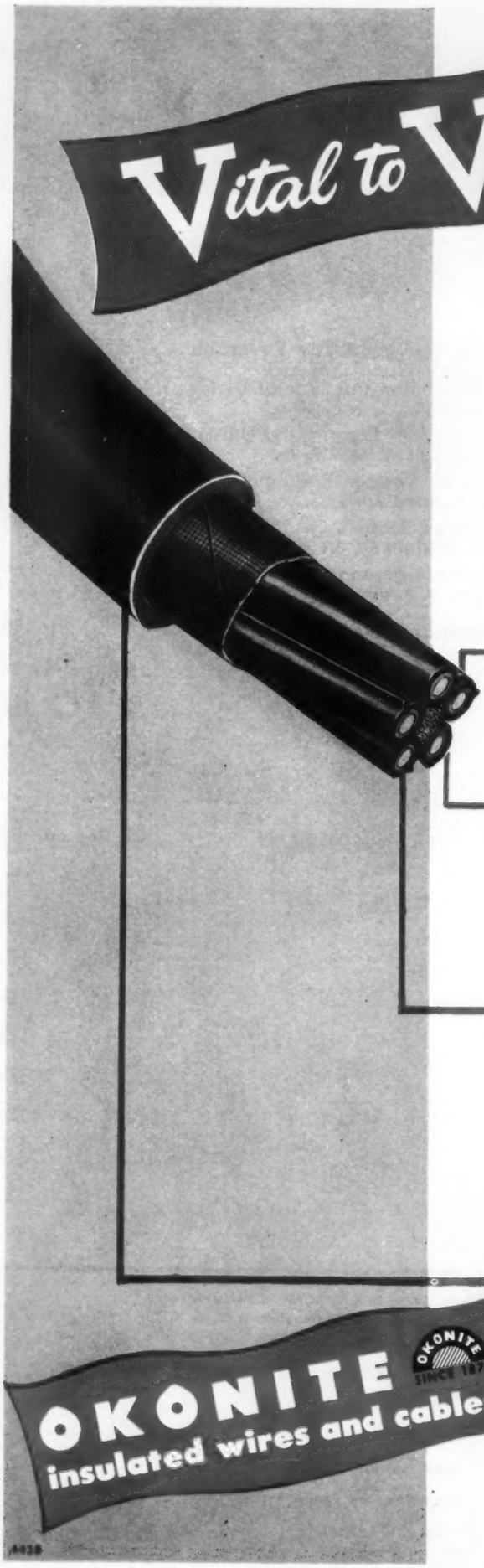

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Electrical World

MARCH 30, 1946

Construction Outlook

IN THE annual statistical number of ELECTRICAL WORLD it was reported that the capital expenditures for new construction by the electric light and power companies of the United States budgeted for 1946 would be nearly a billion dollars. In only one previous year did the industry spend more than the amount projected for this year.

Since that time, however, strikes in steel, copper and electrical goods have so seriously curtailed the production of equipment needed to carry out that construction program that the amount completed by the end of the year is bound to be less than the first-of-the-year estimate. If, however, the strikes are all settled reasonably soon, the year can close without too great a reduction of planned expenditures, if there is cooperation and teamwork all around.

This is said with full appreciation of the great shortages in both labor and materials and with a full realization that the labor supply may become much more critical as the year advances. Unlike other industries, the utilities cannot wait until the demand arises before taking steps to supply the needed generation and distribution facilities. Electric service must be ready when the need for it arises. New load is growing and will grow faster as current-consuming devices become more plentiful. Already new seasonal peaks are developing. The utilities, therefore, cannot, must not, let new construction fall too greatly below the estimates of a few months ago.

The manufacturers are alert to the situation, and can be counted on to do their utmost to prevent any serious curtailment of needed construction from occurring. For that reason it may be necessary to make preferential deliveries in critical situations. The problem can be handled without too much inconvenience if buyers will have patience and be willing to accept partial or tide-over deliveries to help somebody else out of a tight spot.

Nothing, however, will be gained in this situation by pyramiding orders. Such a practice will merely result in adding confusion to an already greatly disturbed market, and if the situation were to become too bad it might result in a return of some form of government control.

During the war, acute shortages were frequently alleviated by drawing on excess inventories of other power companies. It is doubtful if any company would consider any of its inventory as excess under today's uncertain delivery situation. Nevertheless, it is possible that companies can help each other out in emergencies and in that way make the most out of the aggregate industry inventory.

There is still one more way in which utility buyers can improve their own situations and that is by ordering standard products, and by refraining as much as possible from specifications that require considerable engineering on the part of the manufacturer. If suppliers could confine their production to a small number of standard types and sizes, they would be able to give customers considerably more equipment than they can under the present conditions of very short runs. At this time, at least, it would seem as though individualism could give way to standardization. In other words, from here on in, human nature will play an important part in determining the amount of construction that will be completed during this year.

Isolated-Phase Bus Experience Dominantly Favorable

Users cite avoidance of interphase faults, ready installation and adaptation, safety and flexibility of design as incentives—No damage or disturbance under fault conditions—No thermal difficulties—Some adverse experience with dust infiltration—Encloses some auxiliaries

WATERSIDE STATION of Consolidated Edison Co. in New York pioneered the use of the isolated-phase bus and the story of the installation was told in ELECTRICAL WORLD in the issue of October 9, 1937. Since that time there have been a considerable number of other installations of a comparable nature. In fact, the successive adoptions seem definitely to be taking on the pattern of a trend. Assuming this to be a fact, it appears desirable to ferret out the experience had with this type of bus design so that the conclusions can be a guide to further evolution.

To this end questionnaires addressed to ten owners of installations brought detailed replies from the following, in addition to two that asked that names be not identified:

Pennsylvania Electric Co.
Gilbert Associates (Jennison Sta.)
Consolidated Edison Co. of N. Y., Inc. (2)
Tacoma (Wash.) Light Department
Bureau of Reclamation (2)

Continuity of service is cited as the prime objective wherever the isolated-phase bus structures have been installed. The corollary aim of eliminating short circuits between phases takes second place among engineers queried as to their acceptance of and experience with this newer form of station bus installation. All but one of seven utility systems reporting name these two purposes as taking top rank.

Adaptable in Design

Readiness with which the installation can be made and with which it can be accommodated to the housing of equipment terminals and the enclosure of

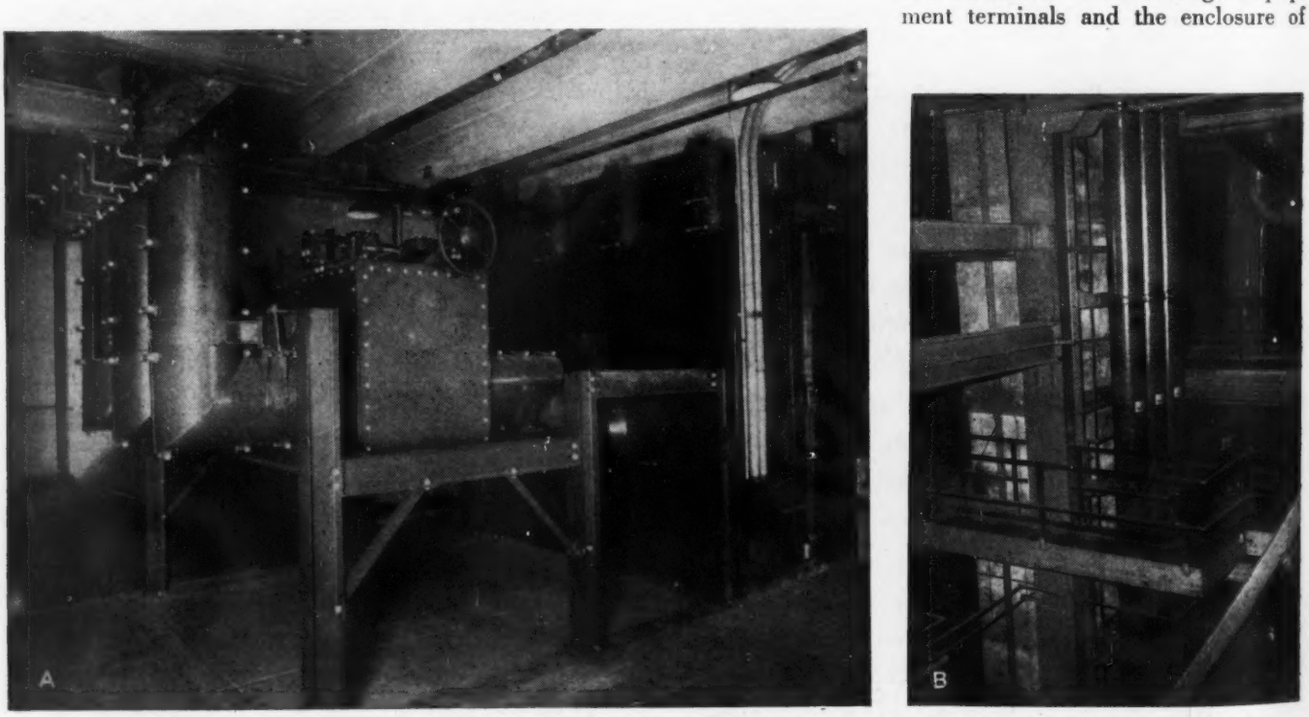


FIG. 1—Isolated-phase bus construction at the Sherman Creek generating station of Consolidated Edison Co. of New York, Inc.: (a) For the synchronizing bus. (b) For the leads from generator to bus. Auxiliary devices readily adapted

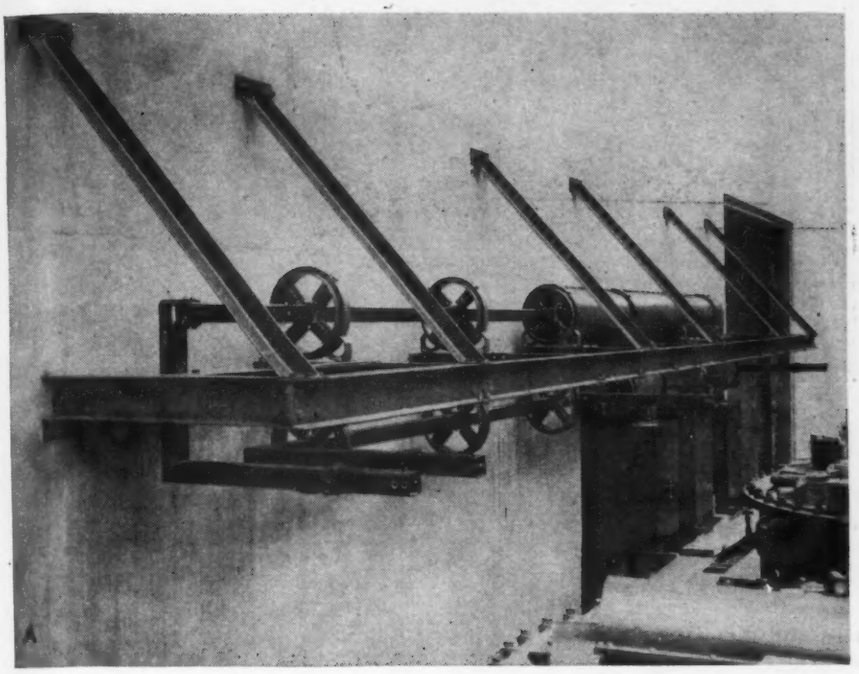
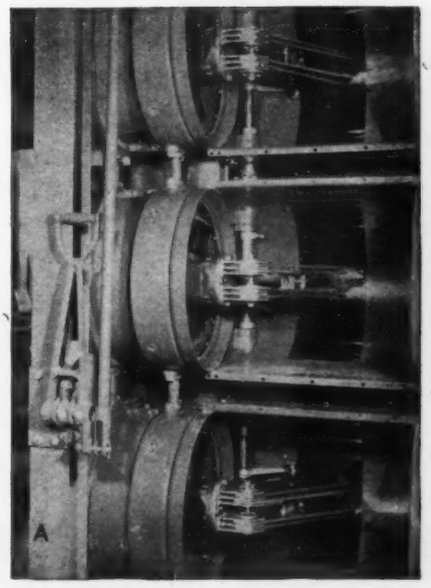


FIG. 2—Isolated-phase primary bus in process of installation at La Grande power house of Tacoma (Wash.) Electric Department: (a) Outdoor section of primary bus. (b) Station service bus with cabinet for various auxiliaries

such auxiliaries as current transformers comes next in order of importance. Of ensuing importance appear to be the following items; bettered safety, saving of space, affording of an adequate ground bus, permanence, reduction in maintenance. Still further items registered as merits, though less unanimously, were these; ease of inspection and verification, good appearance, ease of introducing fire and dust-excluding baffles, flexibility of design and simplification of relaying. Structural aspects such as absence of organic insulating materials, balance of magnetic induction and subjection of the supporting insulators only to compressive forces were given minor mention.



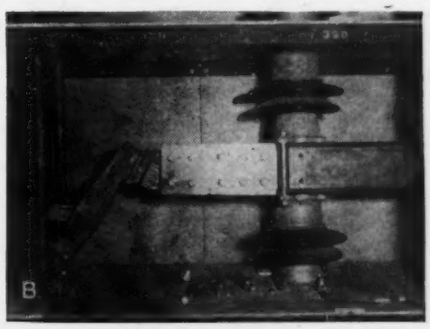


FIG. 3—Isolated-phase bus in process of installation or alteration at Boulder power plant of U.S. Bureau of Reclamation: (a) Involving R.&I.E. 23-kv., 4,000-amp. air switch. (b) Square section single-wall housing of war time made of Transite in lieu of stringent copper sheet

Exclusion of Dirt

Naturally, there were angles of dissent on some points but these were hardly vehement and certainly not condemnatory. One was the matter of entrance of dirt and the associated problem of cleaning the enclosures. Part of the group said other construction work was in progress when the isolated-phase bus was installed and some dust and dirt did get inside but it was not serious. At Boulder Dam there was adverse experience with dust leakage through the joints of the single-wall shell or through the housings of connected auxiliary equipment; it was not felt that the gasketed joints were admitting dust.

The trouble was irksome because it necessitated annual cleaning of the insulators, with removal of at least the alternate covers in a total of 700, scaffold erection and tackle being necessary at several points. Also, considerable skill is required to reassemble the housings without injury to the joints and gaskets. Maintenance at the more difficult locations is not scheduled unless a 24-hour outage can be accorded. The remedy for this single adverse experience is considered to be one or more of the following: (a) use the double-wall enclosure, (b) provide breathers with air filters at low points of the present installation, or (c) force dry filtered air through the bus structure under positive pressure, say 1 in. of water.

Conduciveness of Design

As to factors of the station design conducive to the use of the isolated-phase bus, there were several mentioned. One was the fact that the generator was connected solidly to the transformers, with no low-tension bus or intervening circuit breakers. Another factor was that, to secure the objective of reliability, the metal-enclosed type of installation was the only one adaptable in the available space. The

relatively high current carrying capacity and high short-circuit capacity were included among factors conducive to selection of the isolated-phase bus design. This same point was added by one utility to the list of merits of the design.

As for alternative measures, all but one response said there were no equivalents in the direction of layout and relay protection. One reply did mention Oil-o-static cable as worthy of alternative consideration.

Cost and Extension

One reply said the other types of construction to achieve the equivalent of phase isolation were somewhat cheaper and another concurred with the expression that the isolated-phase assembly is the most expensive in terms of over-all cost. However, one said costs compare "fairly well" and another that "with journeyman wages at $1.65 the cost is about the same as for concrete cells."

Asked was the question whether it was considered "that the design lends itself readily to piecemeal installation, expansion and extension." Without exception the answer was in the affirmative, the only qualification being, in a single instance, that the attribute exists only if provision for the expansion or extension is made at the time of the initial installation.

Cleaning Interval

Intervals between cleaning periods range up to five years. At the other extreme is the suggestion that cleaning should be at least once and possibly even twice a year but in some instances this can be extended to five years; this comment came from the Bureau of Reclamation, already cited as having had some unfavorable experience with dust and dirt. In between was an installation which had gone 18 months since energizing without cleaning. It seems evident that frequency of cleaning depends on ability to seal the enclosure throughout and thus prevent the influx or inhaling of dust-laden air.

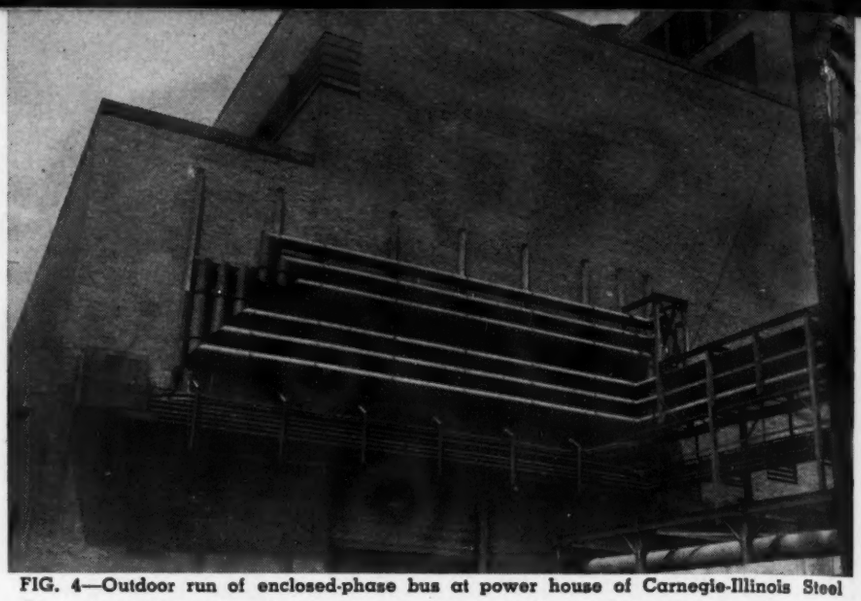


FIG. 4—Outdoor run of enclosed-phase bus at power house of Carnegie-Illinois Steel Corp. steel plant. Generators can be connected solidly to outdoor transformers

Experience in General

Lest any factor be ignored in the inquiry, the broad question was asked: "What adverse experience have you had with the installation in any respect?" Five of the eight answers simply said "none"; one said "none since energized 6 weeks ago," and another, "not yet energized." The eighth merely referred to the matter of dust infiltration already cited.

One of the Consolidated Edison stations has had two operating errors since installation of the isolated-phase bus and these were of 1,500,000- and 1,000,000-kva. estimated value respectively. No damage was done to either bus or enclosure and there was no effect on the operating personnel. The Boulder installation has been subjected to generator short-circuit acceptance tests and the values were about 50,000 and 100,000 amp. instantaneous. In neither case was there any damage.

None of the other installations, on which reports had been received, had experienced a fault that functioned to impose a test of the strength and capability of the isolated-phase bus installation.

Temperature and Space Factors

No trouble was reported as attributable to temperature and thermal expansion, either at anchor points, slip joints,

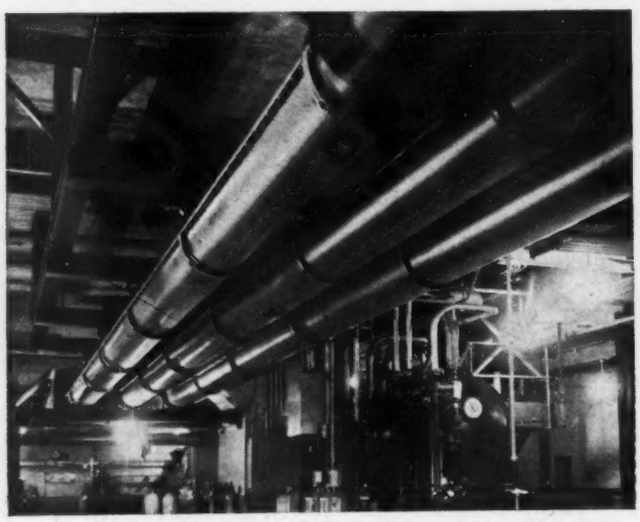
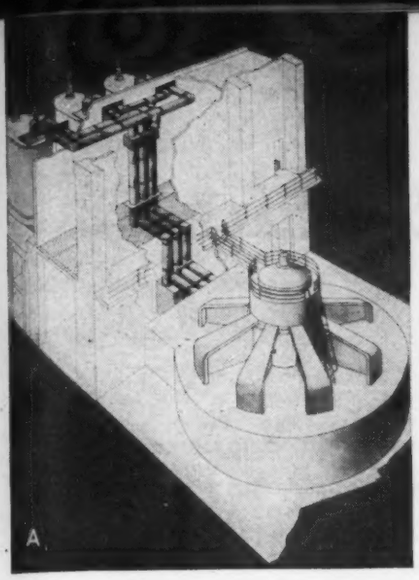


FIG. 5—Isolated-phase bus carried at ceiling of boiler room in Williamsburg station of Pennsylvania Edison Co.

FIG. 6—Outdoor run to transformer station at steel plant enclosed and phase-isolated to protect against deposits for dirty atmosphere



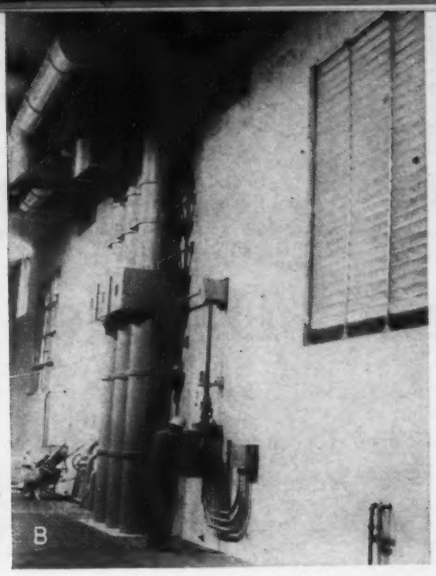


FIG. 7—Schematic (a) and actual (b) layout of the generator-to-transformer runs at Grand Coulee; 13,800-volt metal-enclosed bus installed inside and outside of station

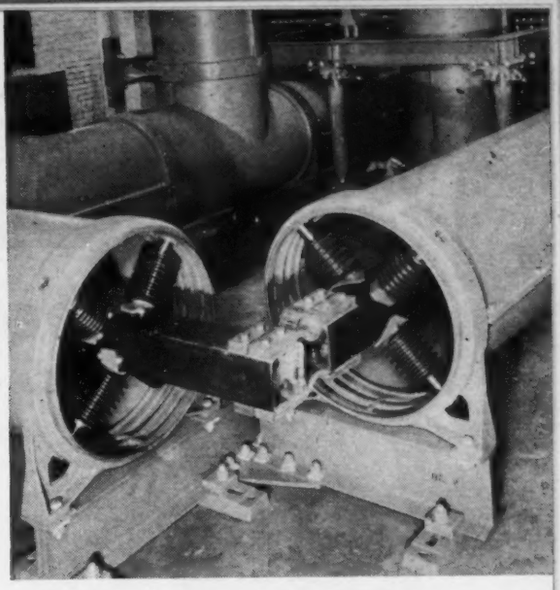


FIG. 8—Details of right angle expansion connection in 5-in. bus at Grand Coulee

insulating baffles or disconnect switches.

To get at the matter of comparative space requirements this question was asked: "Does this type of construction involve increased over-all dimensions and, if so, do you consider this a handicap?"

Weight of the replies is that it neither takes more space nor would it be a serious handicap if it should. In fact, one reply, for a job just about to be installed, is that over-all dimensions are reduced if this type of construction is used; the estimates, however, indicate that the cost is "slightly more than concrete cell construction but the advantages justify the increased cost." In this connection it is cited that the double barriers with air space between give assurance that considerable time is sure to elapse before a phase-to-ground fault will develop into a polyphase fault. Of course, polyphase faults may result from concurrent failures of more than one phase to ground.

Countering these favorable opinions is a single negative belief that the bus of isolated-phase construction does take somewhat more space and that it may be the case in instances where additional space is not only expensive but difficult to provide in the station design.

Suggestions for Betterment

Toward possible improvement in design there was a suggestion that provision be made for keeping the ducts under constant pressure of cleaned air. Another tip was to render the covers less difficult to remove for maintenance and inspection. Three users offered no suggestions.

In the direction of possible modification to permit broadened application, just two suggestions were offered but neither intimated what new uses might thus be encouraged. One of the suggestions was in favor of such standardization among manufacturers that users may be free to "place subsequent orders with any manufacturer." The second suggestion was that some way be found to reduce the cost of an isolated-phase bus installation.

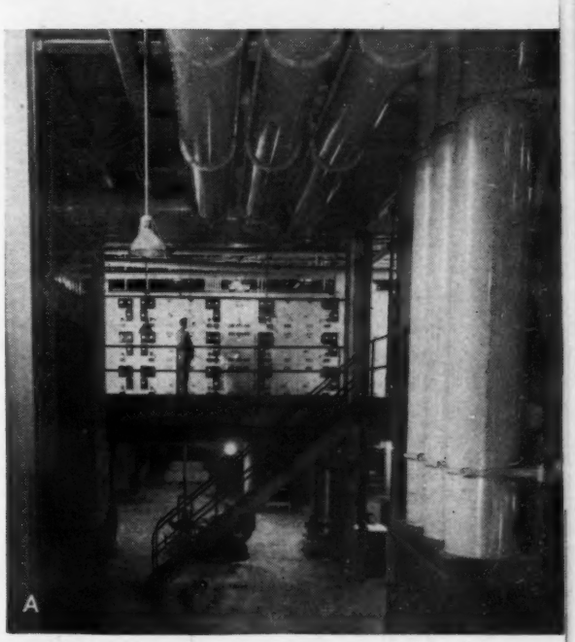
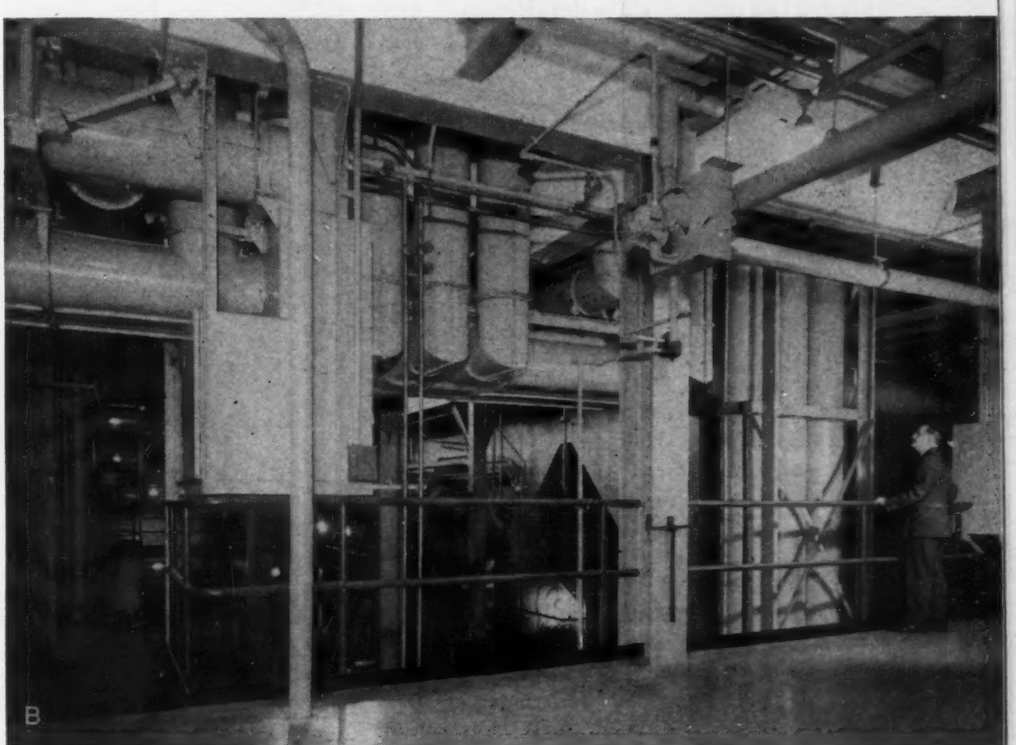


FIG. 9—All aluminum isolated-phase bus was installed at Jennison station of New York State Electric & Gas Corp. (a) Passing through the boiler room. (b) Adaptability to congested conditions is manifest. Isolated-phase bus enclosure was readily applied despite the fact that the station was originally laid out for use of cable



"Snow Buggy" for Line Repairs On Continental Divide

Search for mechanical emergency transportation to remote areas of Rocky Mountains for transmission line repairs during winter ends with use of half-track snow motor developed for the Army

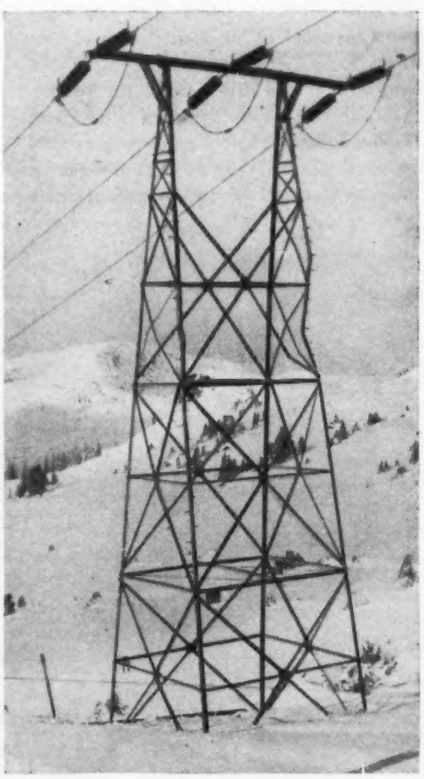
G. C. FARNSWORTH, Transmission Engineer, Public Service Co. of Colorado, Denver, Colo.

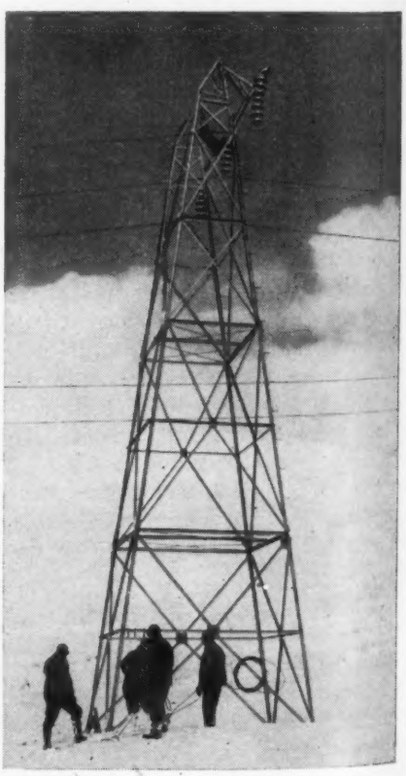
SOME of the highest and most inaccessible transmission lines in the world are operated by the Public Service Co. of Colorado. The Shoshone-Denver line is 155 mi. long and crosses the continental divide three times, twice at an elevation of 12,000 ft. and once at 13,525 ft. Not until snow motors were developed for Army use was an answer found to the problem of transporting men and materials into the snow regions for winter repairs. It is hoped that recent purchase of a Government surplus Allis-Chalmers type M-7 half-track snow motor ends a long search for a means of emergency transportation to remote areas of the high Rockies during winter.

The machine illustrated weighs some 2,500 lb., has a light-gage steel body seating two persons, and a durable canvas top with side curtains. It is powered with a four-cylinder Willys engine and has six speeds forward and two in reverse. The front end is carried on interchangeable wheels or skis, or both may be used at the same time as the skis clear the ground about two inches when the wheels bear the weight. Since the wheels fit into a recess in the side of the skis they offer little resistance when running through snow. Steering is by means of a steering wheel that turns the skis or wheels. The caterpillar-type half-tracks on the rear are of light-gage steel coated with rubber to prevent snow sticking to them. Each track is provided with a foot brake suitable both for stopping and as an aid to steering. Secret of success of this particular machine seems to be in the distribution of weight.

Severe storms of the past winter afforded an opportunity for the equipment to prove its worth. In a freak December storm, rain turned to ice at elevations over about 11,500 ft. Wind velocity was estimated in excess of 100 mph. Line trouble developed in 13,525-ft. Argentine Pass. A patrolman on snowshoes started for the scene from the East side and two men with the "snow buggy" with repair material went up from the West side. The broken conductors were found and repaired and all three men came down on the snow buggy. The job took about eight hours. Otherwise, the men would have had to snowshoe up, spend the night in an emergency shelter cabin on the pass, do the repair work and snowshoe down, taking at least two days for the job.

The same storm damaged some towers in another pass 61 mi. away. Here



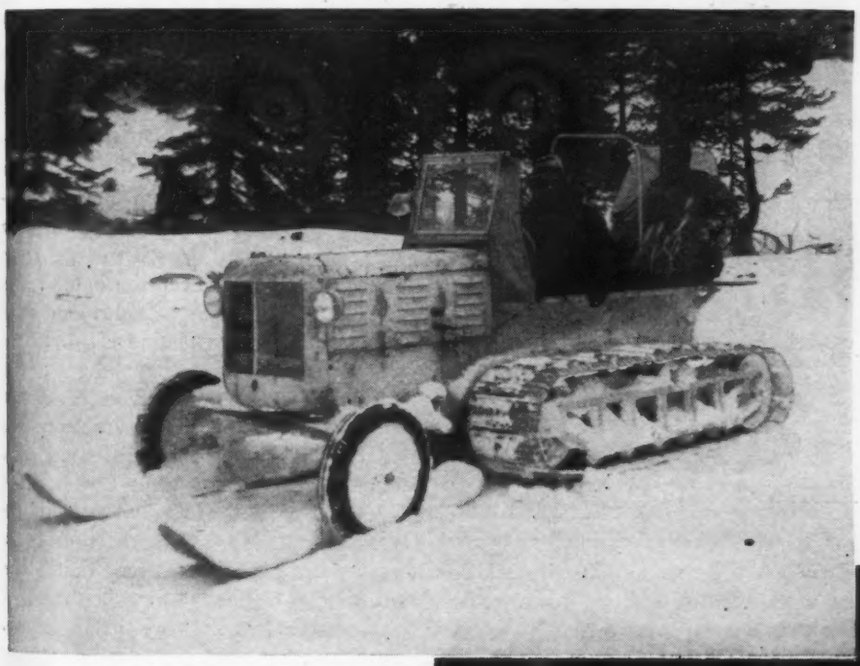


BUCKLED TOWER LEGS (left) is only one of many troubles that may be experienced during winter storms on Continental Divide. Top of tower (right) buckled over from weight of ice on 110-kv. transmission line on 13,535-ft. Argentine Pass. Snow motor now provides emergency winter transportation for men and materials to make repairs

the snow buggy again did yeoman service by shuttling back and forth over a 13½-mi. route between an emergency shelter cabin and the end of a cleared road, carrying bedding, food, equipment and large pieces of steel. The top of the pass at 12,000 ft. was completely glazed with ice and at lower elevations snow ranged from 2½ ft. to drifts 10 to 15 ft. deep, some along a shelf in a sheer cliff. The snow buggy could haul three men and some supplies each trip and could make three 27-mi. round trips a day. The trip by snowshoe would have been a day's work alone and to have moved materials and supplies by snowshoes would have been a staggering job.

The Public Service Co. has tried several different types of snow motors from time to time including an amphibious weasel, but the type M-7 is the only one that has proven successful. It has plenty of power and will make around 12 to 15 mph. once it has a trail packed. It is economical, running on about a gallon of fuel an hour under fair conditions. It will climb a 30- to 35-percent grade, even in new snow, if both tracks have equal footing, and it will run along a steep side hill if too much climb is not attempted at the same time. It would be very difficult if not impossible to tip it over. The ease with which skis and wheels may be interchanged is an excellent feature and the fact that both may be used at the same time makes it suitable for running over alternate patches of snow and bare ground. Depth and kind of snow make little difference, although very loose, granular snow gives it some trouble on steep grades. Everyone is enthusiastic, particularly workmen.

"SNOW BUGGY" successfully negotiates deep snow drifts on way to summit of Rocky Mountains with load of material for emergency transmission line repairs



FRONT END of snow motor is carried on interchangeable wheels or skis with caterpillar-type half-tracks on rear. Skis clear ground about 2 in. when wheels bear the weight. Tracks have brakes for stopping and aid to steering

SOFT SNOW is no barrier to "snow buggy." Speed of 12 to 15 mph. can be made once a trail is packed. Vehicle has six speeds forward and two in reverse; will carry three men and supplies

Hay Drier a Profit Maker for Both Farmer and Utility

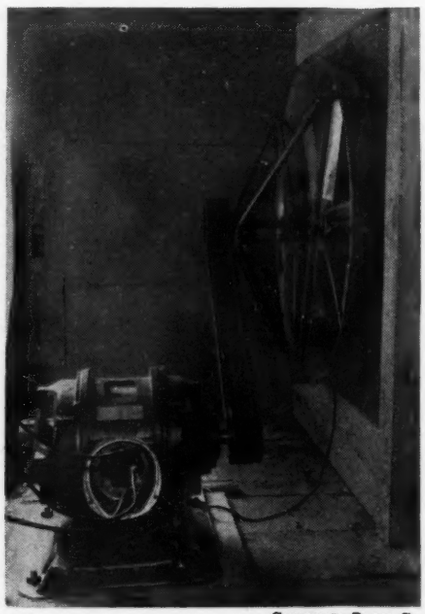
Fan-motor combination can be put to many uses, greatly increasing its value to the farmer and making it a much more desirable load on the lines of the supplier of electric service

CARL JERRINGS, Rural Service Representative, Rochester (N. Y.) Gas & Electric Co.

THERE ARE around 1,500 hay driers now installed in this country. About two-thirds of them were put in in the past three years, when materials were scarce, electrical and mechanical equipment hard to obtain, and conditions generally unpropitious. No other application of electricity has so captured the farmer's imagination because no other promises so much in profit. Hay is the universal stock feed. It is the biggest crop and of all major crops it is the most subject to loss by causes of bad weather, handling, and deterioration in storage. No wonder then that the farmer is closely watching hay drier development, is enthusiastic over its possibilities. Now that war curbs are released and materials and equipment are becoming available, it is to be expected that this recent addition to electricity's service on the farm will surge forward into rapidly widening application. This is an estimate, summarized by George Kable, editor of *Electricity on the Farm*, of what he asserts is a hay cure finisher, not a drier.

Its name and the early forms of its application have implanted certain misconceptions regarding the mow hay finisher. Some farmers have started off on the wrong foot, thinking that the finisher would cure green hay pitched into the mow right after it was cut. Utilities have looked askance at the load, regarding it as having undesirable characteristics.

There are hay driers that are exactly what the name states, dehydrators of hay. These are usually large installations, designed for mass production and employing heat as an agent for moisture removal. But this is not what is meant by a hay drier for ordinary



Consumers Power Co.

FIG. 1—Just about completed, this motor and blower installation for a hay drier

farm use. The usual barn installation of motor, blower and air ducts, as Mr. Kable says, is more nearly to be described as a hay cure finisher. The curing is started in the field and completed in the mow. As against complete curing in the field, the final processing by forcing air through the hay pile in the mow has definitely proved its value. Mow finishing minimizes the breaking off of leaves from the stalks in handling and it conserves carotene and other nutritional elements. The better hay thus produced reduces requirements for more expensive feeds and the farmer has healthier and more productive cattle at lessened cost. Also, with the drier the farmer is much less dependent on the weather in making his hay crop.

A principal misconception of the hay finisher is prevalent among suppliers of electric service. Annual hay production in this country is estimated at 100 million tons. It takes 50 to 75 kw.-hr. to cure a ton of hay. The indicated energy consumption is at least 5 billion kw.-hr. That is a potentiality most attractive to the electric utilities. In terms of the individual farm customer with, say, ten cows it means the sale of an additional 1,000 kw.-hr. or more per year. But when does that increase in energy usage occur and from what kind of load does it result? Here is where the misconception enters. The load is looked at as a 24-hr. one of a 5- or 7½-hp. motor lasting a short time during the hot weather when transformers have least overload capacity and when this farmer's neighbors are also running their hay finishers. Looks like a lot of load piling up on the line. Then in a few days it will be gone, not to appear again until next year. Not remarkable then that some utilities looked at the hay finisher load with rather less than wholehearted enthusiasm.

But the farmer and the utility man who think of the hay drier as a fairly large motor installation inflexibly devoted to hay curing are making a mistake. It can be a versatile device capable of other uses and with possibilities of simple modifications that will extend its usefulness even further. It can do more than just cure hay to make itself profitable to the farmer. And its period of operation need not be short but can be extended over a longer time, allowing diversity factor to enter the load equation, to become an addition to farm service welcome to the supplier of electricity.

Experience and experiments with

hay driers on farms around Rochester have given us a better idea of their possibilities and have led us to give considerable thought to their further development. Heretofore the hay finisher has been regarded as a fixed installation. Large motors and fans have been installed supplying air for the entire mow. It now seems to be more practical to arrange to have smaller units which can be moved about and attached to duct systems. Thus, the farmer has greater flexibility and can make more use of his equipment. And hay can be harvested in several cuttings, thus spreading out the operation of the drier over a considerable period of time.

There are a number of portable units in this area which have been used to dry baled hay. Ducts were not required as the bales were piled in such a manner as to provide a main tunnel. Air was forced into this main tunnel and passed out through the bales. Baled hay, if pressed while still a little moist in order to retain more leaves and better color, has a tendency to heat and mold in the center of the bales. Forcing air through the bales prevents heating and mold formation. Many farmers who bale hay are considering the drier for this application.

Farmers in the Rochester area are becoming more interested in chopped hay for feeding on their own farms. To be stored successfully, chopped hay must be of very low moisture content and if it is dusty it is an explosion hazard. The drier allows the farmer to put the hay in a little greener, thus avoiding dust, and at the same time dry, to prevent heating.

The drier has other applications, especially in areas where beans are raised. White kidney and pea beans quickly discolor if they become wet during harvesting. Since air passes very readily through beans, they may be placed on the drier as soon as they are pulled. Many farmers have lost their bean crops in this area because of bad weather. Some have installed driers for beans only, and feel they have made a good investment.

The combine harvester-thresher has greatly facilitated grain production, saving much time and labor. But combine harvested grains have considerable moisture in them which has to be removed before the grain can be stored safely. Fans used for hay driers may offer possibilities in this field. A farmer in Pittsford used a hay drier fan to remove the moisture from some 20,000 bushels of potatoes last fall. Air was admitted through slatted ducts placed on the floor of a large barn basement and exhausted from the top with a fan. Because of the heavy rainfall in this area harvesting was a problem. Potatoes were wet, covered with mud, and could not be stored in this condition. The fan removed the moisture and the owner was well pleased with the results. The smaller fans may have uses on the farm such as ventilation of poultry houses, dairy stables and storages.

Thus it is apparent that the hay finisher can be made flexible and adapted to more than one use, greatly increasing its value to the farmer and the supplier of electric service. Its merits warrant further investigation.

Often it has happened that a barn has burst into flames in the dead of night from no apparent cause. But there was a cause. It was heating of hay or other forage improperly stored and finally raising itself to the temperature of combustion. Forced air circulation intelligently applied can prevent many such fires. There is no record of any barn equipped for curing having been burned by fire starting in the hay. Thus part of the cost of the hay drier may reasonably be charged to fire insurance.

FIG. 2—Air forced through this baled hay will keep it in good shape. Bales are piled in a manner to provide ducts for air passage

The Detroit Edison Co.

Desirable Design Features for Voltage Regulators*

User recommends supplementary details pertaining to bushings, tertiary control of harmonics, tanking guides, sealing of compartments, rust protection, breathers, oil drains, thermometers and manual operation

JAMES A. RAWLS, Virginia Electric & Power Co., Richmond, Va.

WRITING of specifications for regulators has not been considered a very serious matter in the past and too many orders have been placed which mentioned voltage and kva. and little more, but we have learned from experience and now we are more careful about our regulator specifications.

We know that better operation and maintenance will be secured if we include in our specifications certain features that are not ordinarily furnished. The following is a brief description of features which we consider important and which we propose to include in our specifications. If these design features should be found generally desirable, the manufacturers will look more favorably on them and perhaps make a good number of them standard.

Many of these features have been written into our transformer specifications† with satisfactory results. Manufacturers have shown interest and cooperated.

Largely Mechanical

These features are primarily mechanical and do not deal with the electrical circuit to any extent. We realize that improvements can be made on the electrical circuit and plan work on it.

1. The name plate furnished with each regulator shall be mounted at a height of from 4 to 6 ft. above the base of the unit.

Included on the name plate shall be the following information:

(a) Manufacturer.
(b) Serial number.
(c) Type.
(d) Kva. rating.
(e) Ampere rating.
(f) Voltage rating.
(g) Voltage range (number and percent of steps in the case of step voltage regulators).
(h) Short circuit current limits.
(i) Phase.
(j) Frequency.
(k) Temperature rise.
(l) Gallons of oil.
(m) Weight of core and coils (to be lifted when untanked).
(n) Total weight.
(o) Connection diagram. (In the case of step regulators, a tabulation showing percent change, and corresponding tap changer position.)

2. The following certified drawings and test reports are required for all regulators with a capacity of 24 kva. or above:

(a) Name plate diagram.
(b) Outline dimension drawing, showing various weights and amount of oil required.
(c) Detail drawings for all bushings supplied on regulators above 45-kva.
(d) Copy of standard certified test report showing values for potential tests, losses, exciting current and zero sequence impedance. Values of power factor have not been established as a guide to interpreting Doble tests but we feel that Doble test should be made from windings to ground with limiting values of power factor to be assigned. With the exception of solid porcelain bushings, the power factor of regulator bushings should not exceed 2 percent.

3. Liquid or compound filled bushings should be supplied for all voltages above 15 kv. As no standard bushing opening has been required for regulators, we will apply our design (Fig. 1) for all regulator bushings in the 8.7-, 15-, 25- and 34.5-kv. classes.

Bushings

Trouble has been experienced with the type of bushing that uses a split clamping ring to hold the bushing in place rather than a ring cemented to the porcelain. The new double bushing as supplied by one manufacturer for three-phase step regulators has merit since it allows the source and load leads to be taken away in either of two directions. This is particularly desirable when installing a regulator in conjunction with an outdoor breaker, for in this case, the bushing arrangement on the conventional step regulator should be reversed.

Treating the inside of dry type bushing tubes with conducting paint or glaze should possibly be considered on 15-kv. bushings as a means of eliminating corona. Clamp type terminals should be supplied for external connections to all bushings. Draw lead type bushings should be used wherever possible and clamp type terminals might also be considered on the upper end of the draw lead.

4. All joints in windings or at bushings should be either the brazed, compressed or clamped type—solder connections are not permitted. Loose connections have been found in regulators—consequently, some good locking device for nuts is still badly needed.

5. Three-phase step regulators should be constructed, using a suitable tertiary winding or other means, so that no undesirable harmonics or voltages

* Adapted from paper at 1945 Conference of Clients of Doble Engineering Co.

† "Proposed Requirements for Power Transformers." ELECTRICAL WORLD, May 27, 1944, pages 83–86.

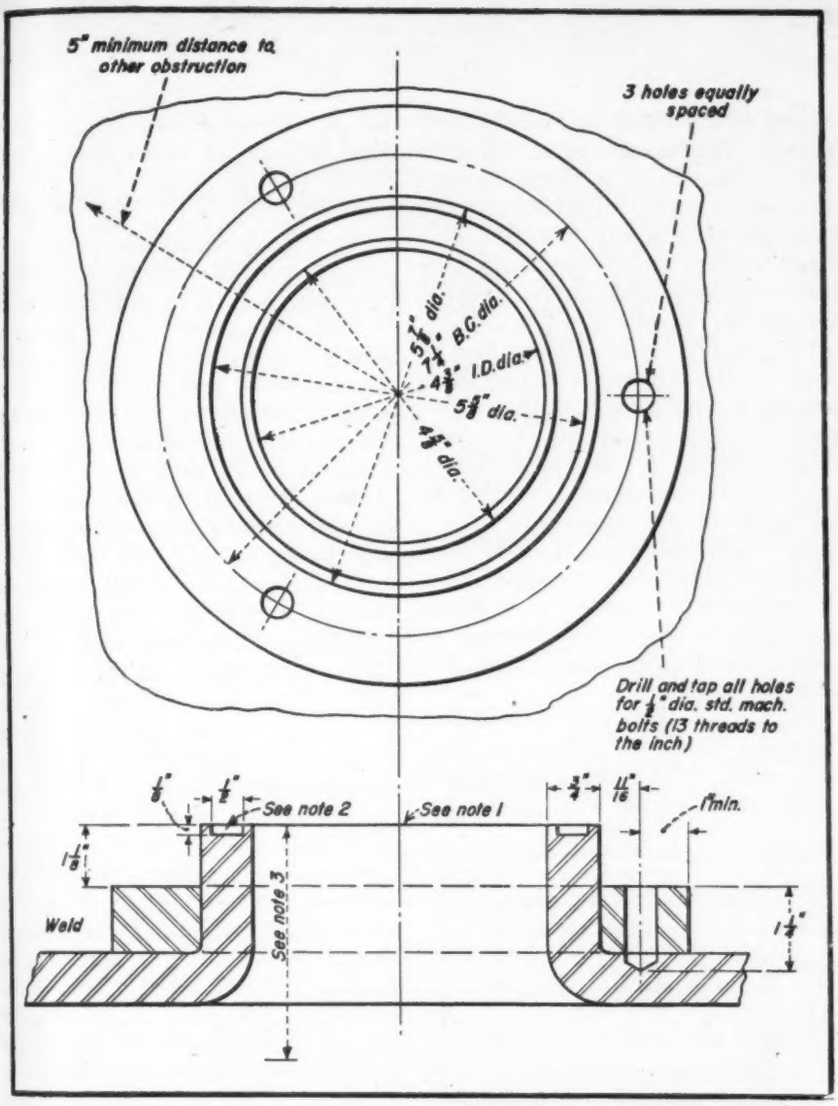


FIG. 1—Opening detail in equipment for 8.7-, 15-, 25- and 34.5-kv. bushings

Note 1. The lip is to be so located above the core, terminal board or other parts of the transformer that a bushing with a dimension of 26 in. from the mounting flange to the lower end of the bushing terminal can be used with adequate clearance.

Note 2. Gasket to fit between lip and bushing or adapter to be 4¾ in. inside diameter and 5½ in. outside diameter. Cork gasket to be ¼ in. thick and corprene gasket 3/16 in. thick.

Note 3. Oil level in equipment to be a maximum of 6 in. below top of bushing opening. (This dimension may be altered by agreement.)

will result if the neutral is not grounded on a grounded neutral system.

6. Tanking guides (Fig. 2) for centering of core and coils are required on all units to facilitate tanking in the field. These tanking guides should be full length rather than at top and bottom only. These guides can probably take the place of any centering arrangement now used.

7. Suitable bypass lightning protection shall be provided on all step voltage regulators.

8. All secondary control leads should leave the regulator tank above the oil level. An oil-tight terminal board is preferable where these leads leave so that oil will not follow the leads to the control equipment.

9. Except in the case of very small regulators, the control cabinet shall be mounted on the regulator tank. A hinged control panel is required.

10. We feel that it is desirable to have the transformer compartment of step regulators completely sealed from the mechanism compartment so there cannot be any interchange of oil between the two. In doing this, it may be found to be much more difficult to remove the regulator parts from the tank for inspection and maintenance. However, provision can thus be made to let the tap-changing compartment breathe while sealing the transformer compartment. Trouble has been experienced when the leads from one compartment to the other pass over a barrier. Condensation occurs where the leads are above the oil and we have had failures where they are bunched together in passing compartment barriers.

11. Standard voltage ratings and ranges with the number of steps in the case of step voltage regulators have been set up which meet our requirements.

12. The control on regulators has been standardized to a large degree. Contact-making voltmeters have been a source of considerable trouble, but these have been materially improved and it is hoped that this improvement may be carried further. An *adjustable* time delay relay (contactor) is desirable on step regulators above 5-kv. rating in order that they can be operated satisfactorily in series with each other. It would prevent undue operation of tap-changing mechanism by giving regulator nearest the load a chance to take care of the voltage condition without causing the regulator back of it to operate.

13. It is desirable to have the power supply for the operating motor and the contact-making voltmeter supplied by independent power or potential transformers. When supplied from the same transformer, it is possible for the current of the operating motor to lower the voltage on the control circuit enough to cause the contact-making voltmeter to make contact and raise the voltage.

14. All voltage regulators shall be tested at the factory in accordance with the latest recommendations of the AIEE and NEMA.

Rust Protection

15. Rusting has been noted on the bottoms of regulator tanks within a year after installation. Better ventilation of the tank bottoms may remedy this condition, but it may be desirable for the manufacturer to supply special treatment on the bottoms of the regulators. If a special treatment is used, it should cover all surfaces not readily accessible for painting when the regulator is resting on its foundation. Metal spraying of zinc and lead may eliminate rusting and make expensive paint jobs unnecessary. Treating the bottoms with a heavy greasy compound

similar to that used on steel winch and tramway cables is a possibility.

16. Adequate breathers (Fig. 3) should be installed on all regulators. On the larger size regulators silica jel or activated alumina breathers should be considered. Breathers should be so located that snow cannot build up around them and so that rain cannot bounce into them.

Complete sealing of induction regulators and the transformer compartments of step regulators is a possibility. Rusting has been noted on the underside of covers on regulators. Breathers should be so located as to give cross ventilation to help remedy this. The control cabinets should also be equipped with suitable breathers.

17. Gasket retainers and metal to metal stops are required for all gasketed joints. Retainers shall be installed so as to prevent the trapping of free moisture between the retainers and gaskets.

Oil Drain

18. A valve for draining the oil from regulators, as well as for a lower filter press connection, shall be installed on each regulator or oil-filled compartment of a regulator. If the regulator tank or compartment includes over 50 gallons of oil, an upper filter press connection shall be furnished. This upper connection can be in the form of a standard plug or capped pipe nipple, provided the oil in the regulator is not over 100 gallons; in which case, this upper connection shall be a standard valve. One and one-quarter inch valves are desirable.

19. A small oil sampling valve of either the gate or globe type shall be installed so as to remove oil from the lowest part of any tank or compartment. These small valves should be located so as to be protected from mechanical injury.

20. Magnetic type oil gages should be supplied on tanks or compartments of regulators 24 kva. and above.

Thermometers

21. Dial-type thermometers are required on all induction regulators 48 kva. and larger and in the transformer compartment of step regulators 48 kva. and larger. All thermometers shall be installed in a thermal well (with no tube from the well to the instrument). All thermal wells shall be welded into the tank so that the thermometer can be removed at will without lowering the oil in the equipment. The thermometers shall have maximum reset handle through the face and alarm contacts shall be supplied where the thermometer is to go on a regulator 100 kva. or larger.

22. The fiber bolts and nuts used to hold barriers and liners in regulators are not too satisfactory. When these bolts are tightened dry, out of oil, and then immersed in oil, they swell, resulting in numerous bolts breaking in two, or the nut splitting open.

23. When wheels are specified they shall be steel or cast iron of the broad flange type and at least 8 in. in diameter. Wheels usually will not be required for regulators weighing less than 15,000 lb.

24. All radiators shall be welded to the tanks except on units where the floor space of the tank alone (without radiators) is greater than 70 in. by 60 in., in which case the radiators shall be attached with valves.

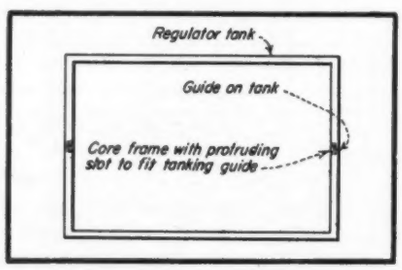


FIG. 2—One form of tanking guide for step regulator. (1) Transformer core frame has protruding slot to fit guide on inside of tank; or (2) core framework can be extended to form guide for each corner of tank; or (3) angles or bars can be welded to core frame and tank to form the guides

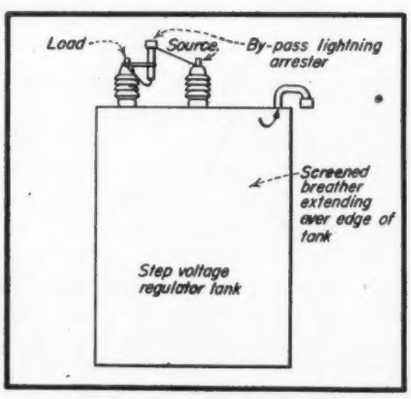


FIG. 3—Breather prevents snow from building up and rain from bouncing inside step-regulator tank. Standard low-voltage, line-type lightning arrester connected between line and source bushings on top of regulator

Cooling Fans

25. On all regulators above 300-kva. capacity three-phase, or 100 kva. single-phase, provisions shall be made so that cooling fans can be added at a later date without drilling or welding the regulators in the field and an extra thermometer oil well shall be furnished. It is only necessary to weld brackets on the tank to support the control cabinet along with brackets on or near the radiators to support standard cooling fans.

26. Jack bosses and lifting eyes are required on all units 48 kva. and larger.

27. Position indicator shall be visible from the outside of all regulators and shall be so located that it can readily be seen from ground level without using ladder. Step regulators shall be provided with a suitable counter for registering each contact change.

28. Covers to tap changer compartments of step regulators should be of adequate size for the proper maintenance of the mechanism. These covers should have handles to facilitate removing and replacing. Hand holes should also be provided on all regulators to facilitate working on the mechanism without removing the cover.

Manual Operation

29. Provisions shall be made so that step regulators can be operated manually from outside the tank. This connection should come through the side of the tank with an oil-tight fitting, or be located so as to be easily accessible in the control compartment. Manual operation of induction regulators should always be possible by removing a hand hole cover on top of tank.

30. A grounding lug of the mechanical type shall be supplied and mounted near the bottom of each regulator tank.

31. Since the regulators will normally be installed outdoors in an area close to residential and commercial establishments, they should operate quietly. This should be kept in mind in the design of the complete unit, including the fans where forced air cooling is used.

32. All regulator units should be built in accordance with the latest AIEE and NEMA standards except where these conflict with the desirable features mentioned above.

Quick Guide to Rural Voltage Drops

Family of curves aids in predetermining voltage drop on 7.2-kv. rural distribution circuits for various load densities and for conductors from No. 6 to No. 4/0—Ready indication of need for feeder regulators—Reveal whether more elaborate calculations are desirable

H. N. MULLER, JR. and D. L. WHITEHEAD,* Westinghouse Electric Corp., East Pittsburgh, Pa.*

DURING the past decade a large number of single-phase, rural distribution circuits have been constructed in this country. The power industry is looking forward to a much greater expansion of this market in the post-war years. Because of the relatively low load densities encountered in rural areas, and because of the length of lines thus needed to serve customers desiring electric service, voltage regulation is frequently the limiting factor in the ability of the supplier to provide satisfactory service.

In construction of rural circuits a large number of different conductor sizes are employed and feeders extend through areas where the load density may vary considerably. These two factors make the calculation of voltage drop tedious for any typical rural circuit, and since regulation is a limiting factor, such calculations, although tedious, are frequently necessary. Whether voltage regulating devices are required in a particular case, and if they are required just where they can most effectively be applied, can only be correctly ascertained if the voltage level from source to last consumer is known with at least a practical degree of accuracy.

In order to provide an easily applicable guide to the solution of such regulation problems, general curves rendering voltage drops on typical rural circuits are herein presented. The keynote used in the preparation of these curves is simplicity. The maximum number of practical cases are covered with a minimum of complications.

This analysis presents curves from which the regulation of 1,200-volt single-phase circuits can be easily determined. Fig. 1 shows the conductor arrangement used in determining circuit impedance. The spacing assumed is typical of single-phase distribution circuits in this voltage class. The impedance of this type of circuit can most easily be calculated by the formula

$$Z_{\text{total}} = Z_A - \frac{M^2}{Z_N} \text{ ohms per circuit mile,}$$

where Z_A = line wire Z, ohms per mile,
and Z_N = neutral wire Z, ohms per mile,

$$Z = \left(r_a + \frac{r_e}{3}\right) + j\left(\frac{x_e}{3} + x_a\right)$$

and $$M = \frac{r_e}{3} + j\left(\frac{x_e}{3} - x_d\right)$$

The values of r_a, r_e, x_a, x_e and x_d can be obtained directly from modern conductor tables.†

After having determined the line impedance, the line regulation or voltage drops can be determined by "cut and try" manual calculations for any given loading condition. In order to determine the voltage drops for a representative number of conductor sizes, load densities and line lengths, it became necessary to employ the A-C Network Calculator in the interest of conserving time and maintaining accuracy. The power factor of the loads connected to any particular circuit influences the voltage drop. In order to simplify the curves, a power factor of 85 percent was assumed and reasonable variations from this value will not greatly influence the voltage drop as read from the curves. After an investigation of the load density on this type of feeder in a number of areas, it was found that densities of 2.4 and 8 kw. per mile would cover most of the practical range. In determining the voltage drops on the A-C Network Calculator, the loading for each conductor size and for each load density was lumped in each case into ten equal parts and each load adjusted to draw rated kw. at the particular voltage existing at that point on the line. On an actual system the loads will not ordinarily be equally spaced along the line, but if the load is reasonably well distributed, the curves as shown in Figs. 2, 3 and 4 will give the voltage drops quite accurately.

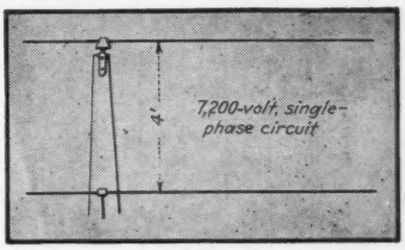


FIG. 1—Typical conductor arrangement for 7,200-volt, single-phase rural distribution two-wire circuit

Illustrative Examples

How the diverse assumptions made in arriving at the general voltage drop curves of Figs. 2, 3 and 4 result

* Central Station Engineers.

† "Electrical Transmission and Distribution Reference Book." Westinghouse Electric Corp. Chapter 3, Page 29.

in usable answers to practical problems, can best be seen by following in detail examples on typical 7,200-volt circuits.

A 7,200-volt feeder is shown in Fig. 6a. The total actual length of line is 39 miles.

To use the curves it is necessary to obtain an equivalent total line length with the same load density on all sections. The selected load density to which all line sections are to be converted should be that of the section through which the drop is being calculated. This conversion to an equivalent load density introduces no significant error into the calculations for typical circuits. Suppose it is desired to determine the voltage drop to point D. First determine the drop through section A-B. Since this section has a load density of 4 kw. per mile, the remainder of the system should be converted to an equivalent length at 4 kw. per mi. The 8-mile section B-C does not require converting as it is already at 4 kw. per mile. The 9-mile section C-D with a load density of 2 kw. per mile will be, as far as voltage drops are concerned, closely equivalent to 4.5 miles at 4 kw. per mile. Then adding the equivalent lengths for each of the sections a total equivalent line length of 34.5 miles is obtained.

Shown in Fig. 5 is a set of voltage drop curves taken from Fig. 3 and drawn to a larger scale in order to show in detail the procedure for determining voltage drops. In Fig. 5 on the curve labelled total equivalent line length find point 1 corresponding to 34.5 miles from the source. From this point sketch in an interpolated curve for a 34.5-mile line as shown by the dashed line. On the interpolated curve locate point 2 which corresponds to 22 miles of a line whose total length is 34.5 miles. This gives a voltage drop through the 22-mile section A-B of 5.6 percent as shown.

To find the voltage drop through section B-C, again use the total line length of this section combined with section C-D. Section A-B is not included in getting the drop for B-C as only the loads on a given section and the loads supplied through that section produce a drop in that particular section. The 8-mile section B-C plus 4.5 miles equivalent length of section C-D give an equivalent line length of 12.5 miles. In Fig. 3 under curves for 2/0 copper follow the same procedure to find a drop of 0.9 percent for 8 miles of a line whose total length is 12.5 miles. To get the voltage drop for section C-D, enter the curves in Fig. 2 under No. 2 copper and find a drop of 0.5 percent for 9 miles of a line whose total equivalent length is 9 miles. Totalling the above voltage drop, a drop from the substation to point D of 7.0 percent is obtained. A convenient form for recording the data is given in Fig. 6b.

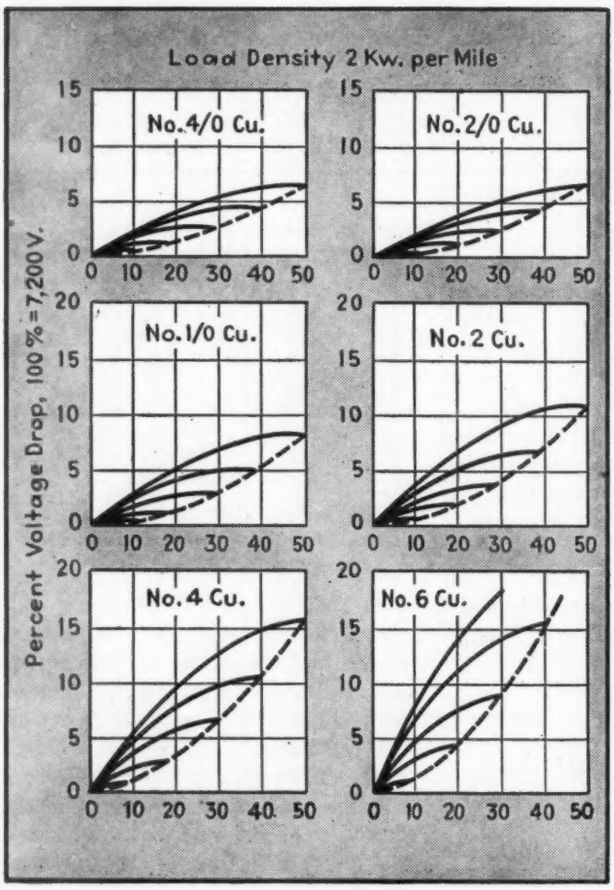


FIG. 2—Voltage drop curves for 7,200-volt, single-phase circuits with a load density of two kilowatts per mile. Solid curves indicate voltage drop at any point along a line whose total length is determined by intersection with dotted envelope curve

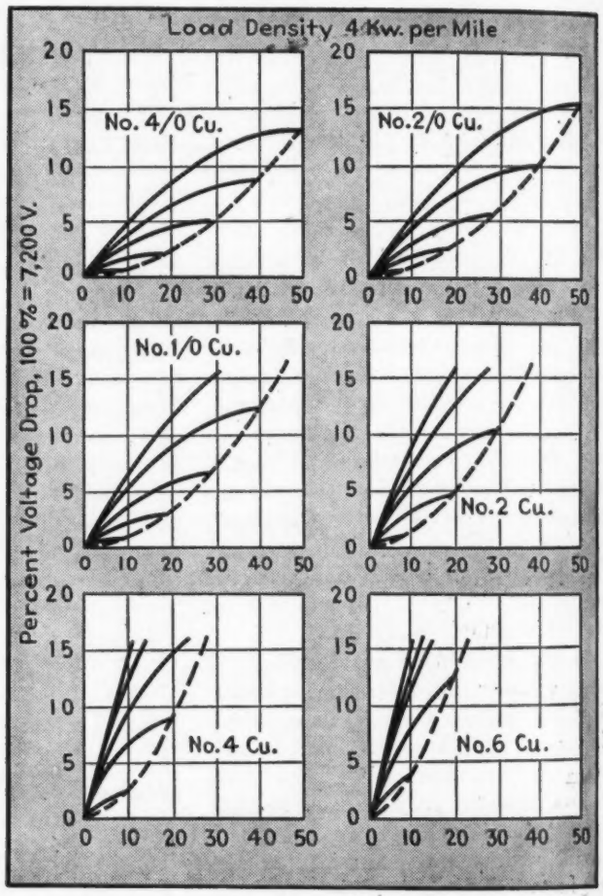


FIG. 3—Voltage drop curves for 7,200-volt, single-phase circuits with a load density of four kilowatts per mile. Solid curves indicate voltage drop at any point along a line whose total length is determined by intersection with dotted envelope curve

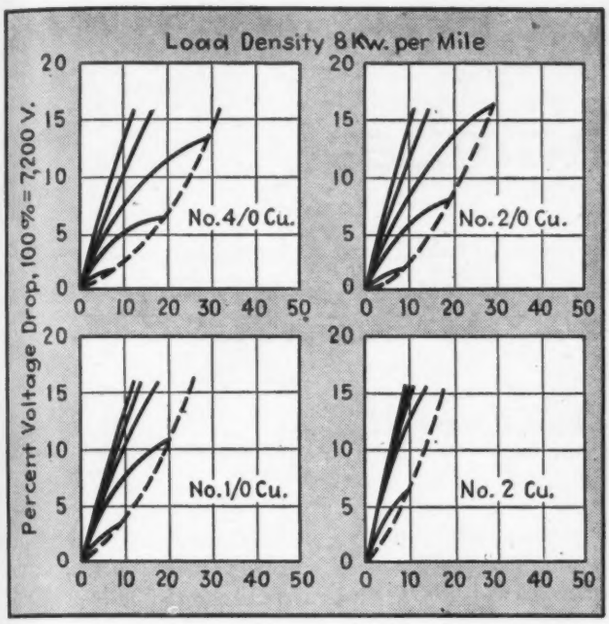


FIG. 4—Voltage drop curves for 7,200-volt, single-phase circuits with a load density of eight kilowatts per mile. Solid curves indicate voltage drop at any point along a line whose total length is determined by intersection with dotted envelope curve

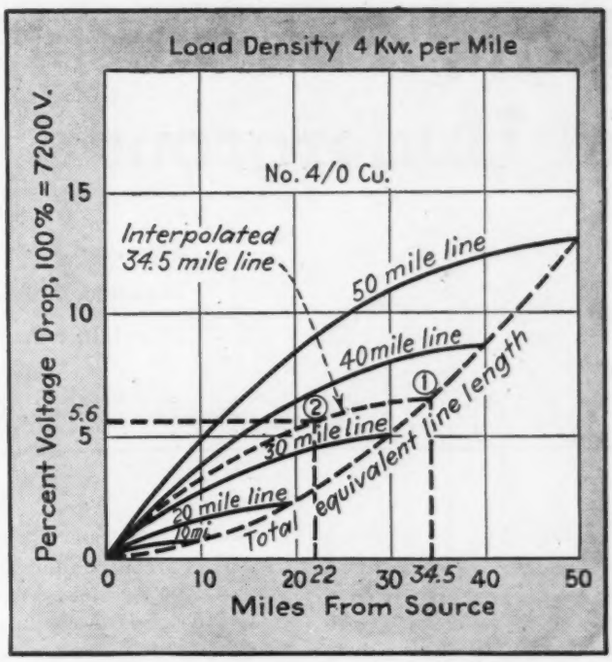


FIG. 5—Curve for No. 4/0 copper conductor with load density of four kilowatts per mile drawn to larger scale showing construction lines; this is from set of curves in Fig. 3

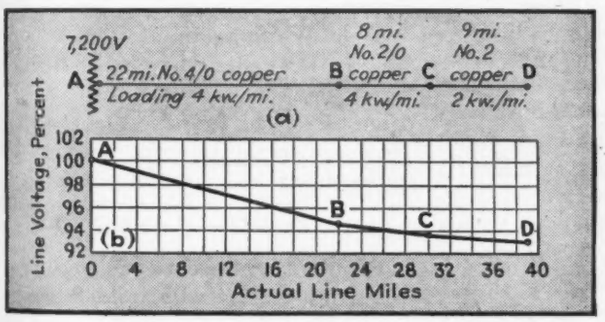


FIG. 6—One line diagram and voltage gradient chart for 7,200-volt single-phase rural distribution circuit

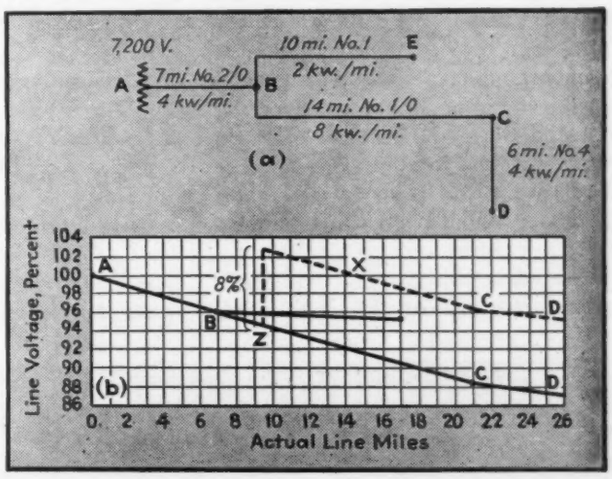


FIG. 7—One line diagram and voltage gradient chart for 7,200-volt, single-phase rural distribution circuit with two branches

Assume a system as shown in Fig. 7a. Suppose it is desired to determine whether regulators are needed in this feeder. First convert all line lengths to equivalent lengths at 4 kw. per mile load density. This gives a total equivalent length of 46 miles. On Fig. 3, under curves for 2/0 copper find the voltage drop of 4.0 percent for 7 miles of a 46-mile line. The voltage drop in section B-C can be found in Fig. 4 under curves for 1/0 copper for 14 miles of a 17-mile line (7.6 percent). For line section C-D find drop of 10 percent for 6 miles of a 6-mile line. For line section B-E interpolate in Fig. 2 between curves for 1/0 and No. 2 copper a voltage drop of 0.6 percent for 10 miles of a 10-mile line.

These results are shown in chart, Fig. 7b. It appears that a regulator or booster could be effectively used in this instance. An inspection of this chart indicates that such a device, if employed, could be put in the line section B-C with good regulation resulting throughout. The dotted line shows one suggested arrangement. A regulator is installed at Z, 2.5 miles beyond B, and is compensated to maintain 100 percent voltage at point X. If the case assumed is maximum loading, then regulation on this feeder will be kept to within about 5 percent of source voltage. Locating the regulator beyond B reduces its size, and consequently investment, since the load current of section B-E is not carried by the regulator.

Conclusion

Cases will arise in practice that fall outside of the range of load densities, conductors, and other parameters covered by the curves of Figs. 2, 3 and 4. These curves are not intended to be a panacea for all distribution circuit voltage regulation problems. They should cover a large majority of the cases involving 7,200-volt single-phase distribution, and in other cases lying outside of the boundary conditions assumed they may still be used as a rough guide in the determination of whether individual detailed calculation is required.

Navy Put Diesel Plant in Underground Chamber

Five diesel-driven generators installed in rock tunnel for security—Two separate buses with bus tie—Metal-clad switchgear—40-ft. shaft to labyrinth entrance with steel doors—Auxiliaries in separate room

CAPTAIN M. S. FITZWILLIAM, Bureau of Yards & Docks, U. S. Navy

AT THE TIME of the attack on Pearl Harbor the Bureau of Yards and Docks, in connection with the Navy's general expansion program, had on order two complete diesel electric power plants which were scheduled for installation to meet the power requirements at two small bases in the Pacific which were overrun by the Japs immediately after the December 7 strike. To provide stand-by power at an important naval base which could be subject to bombing, it was decided to install the equipment on order in an underground location considered to be relatively safe from aerial bombs. The underground plant was to supplement the existing surface plant to provide sufficient power to meet the essential requirements of this highly important naval base in any emergency.

The equipment which was installed in the underground plant consisted of standard commercial apparatus without special design for subterranean installation. Excepting the ventilating fans, provided to insure an adequate supply of fresh air in the engine room and to force out the exhaust gases, the installation of generating equipment, switchgear and auxiliaries was made in a conventional manner adapted to the space available as would have been the case with an above-ground plant.

The major equipment installed is listed as follows:

Two Worthington 1,000-hp. Type EE 8, 8-cylinder, 4-cycle, stationary type diesel engines operating at 327 rpm., each arranged for direct connection to one General Electric 875-kva., 3-phase, 60-cycle, 2,300-volt generator.

Two Worthington 750-hp., Type EE 6, 6-cylinder, 4-cycle, stationary type diesel engines operating at 327 rpm., each arranged for direct connection to one General Electric 652-kva., 3-phase, 60-cycle, 2,300-volt generator.

One Worthington 875-hp., Type EE 7, 7-cylinder, 4-cycle, stationary type diesel engine operating at 327 rpm., arranged for direct connection to one General Electric 750-kva., 3-phase, 60-cycle, 2,300-volt generator.

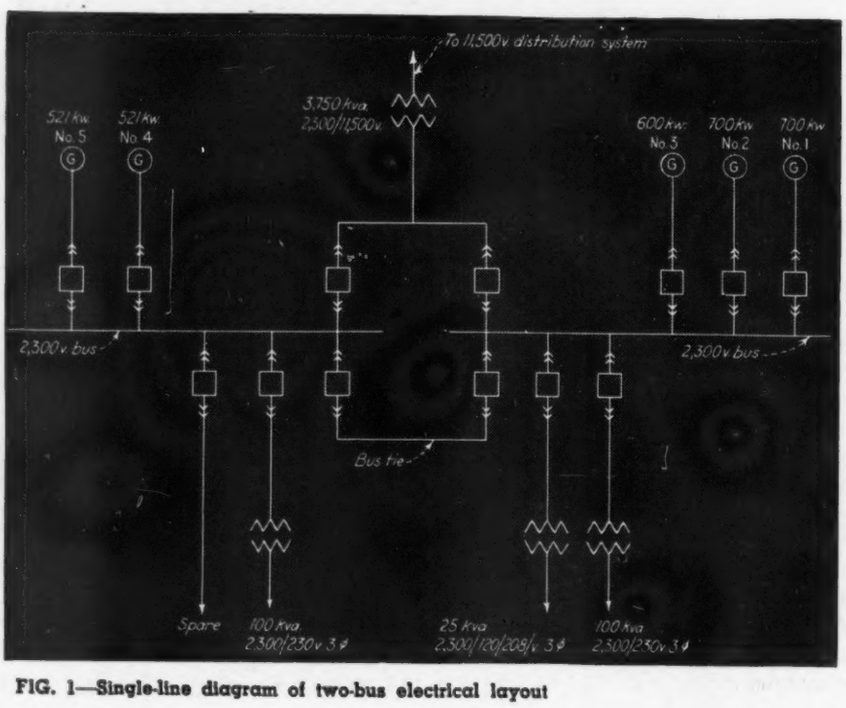


FIG. 1—Single-line diagram of two-bus electrical layout

Cooling and Starting

Standard heat exchangers were provided for cooling with water brought in a short distance by an interconnected water system which assured an adequate supply of cooling water. Compressed air for starting was provided by two motor-driven two-stage air compressors and one gasoline engine driven compressor discharging into a battery of four air bottles. A 20-ton bridge crane with motor hoist was provided for service in the installation and subsequent maintenance of the diesel engines with their allied equipment.

Inasmuch as the equipment had been purchased for installation at two different locations, it was all placed at this single site retaining the separate buses, so that it was not necessary to purchase additional switchgear for the consolidated underground plant. One feeder panel from each set of switchgear was used to effect the tie between the two buses and a similar arrangement was made to provide connection to the step-up transformer interconnecting with outside distribution system.

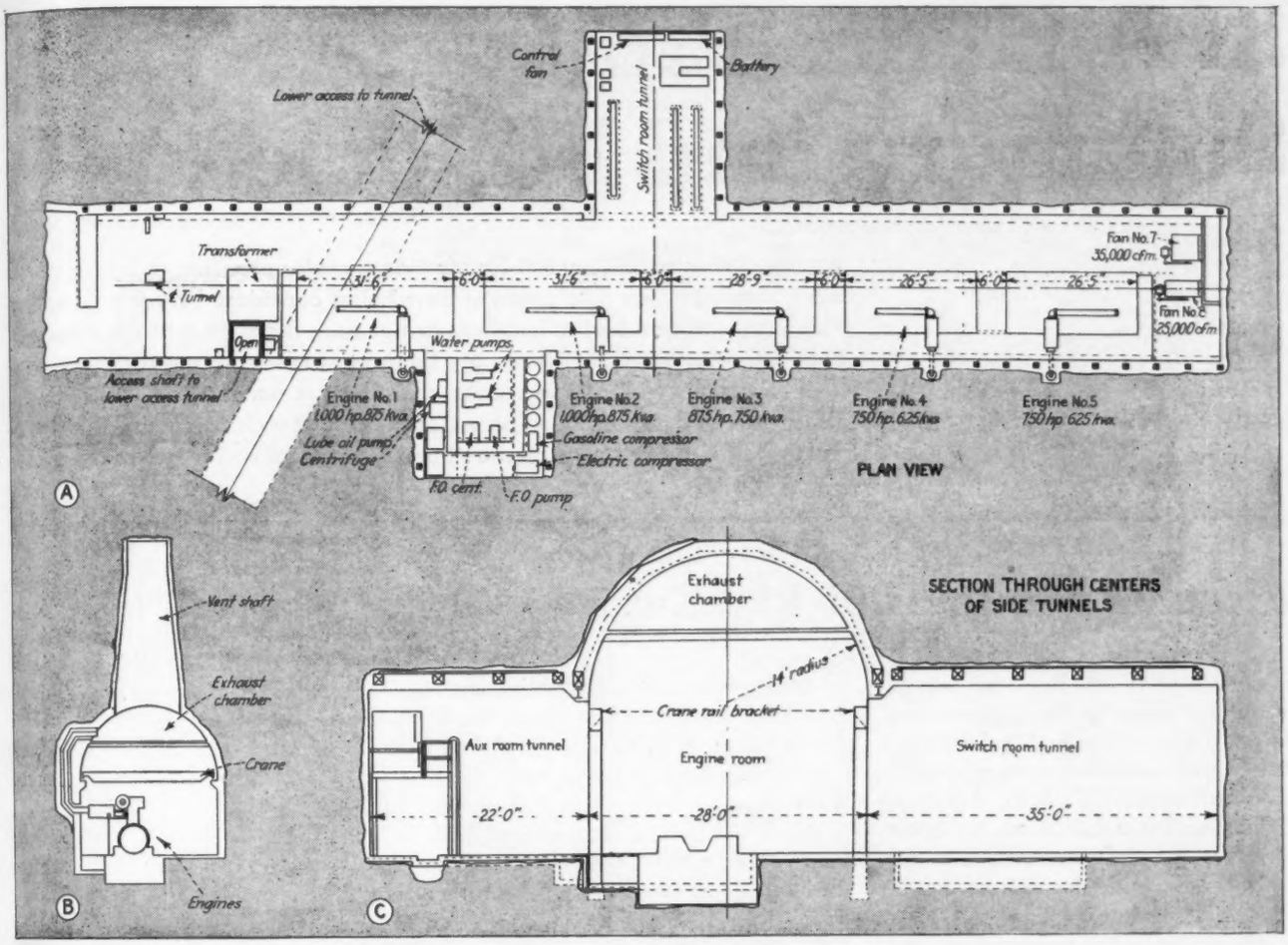


FIG. 2—Plan view (a) and sections (b) and (c) of underground diesel generating plant

Standard metal-clad switchgear was used for both 2.3-kv. buses. A total of thirteen 100,000-kva. breakers was installed: five serving the generators, three for station auxiliaries, two for the bus tie, two on the interconnection with the outside distribution system and one spare. A 3-phase transformer having a capacity of 3,750 kva. was used to step the plant voltage up to the 11.5 kv. of the yard distribution system. A storage battery was provided for breaker controls and emergency lighting.

The plant installation was made in a hillside of solid rock. The engine room gallery was driven into the side of the hill so as to provide a protective rock cover of about 100 ft. Entrance was obtained by a shaft excavated on the slope.

At the time when the installation was designed, the 100-ft. covering of solid rock was considered adequate protection from either aerial bombs or shells then known or envisioned. Whether the protection afforded by the overlay would be effective against atomic bombs or the more destructive aerial bombs since developed is entirely problematical. It is almost certain that a direct hit from either type modern bomb would destroy a plant located as this one was but that the plant would survive hits made a moderate distance away.

Plant Dimensions

The over-all length of the engine room gallery was 229 ft. 3 in.; height was 28 ft. 6 in. and width 28 ft. Switchgear was installed in an offset chamber 24 ft. wide by 35 ft. long. Station auxiliaries were located in a 22- by 24-ft. chamber on the opposite side of the main gallery from the switchgear, both chambers being tunneled into solid rock. A false roof was constructed in the engine room, suspended from the solid rock ceiling by two rows of rods, and was keyed into the side walls so as to be gas tight. The chamber between the suspended roof and the rock ceiling was utilized for the passage of exhaust gases to an outside vent, the exhaust from each engine being brought into the chamber as indicated in Fig. 2.

Timber shoring was used throughout the gallery, which was covered with a two inch facing of gunite. Entrance doorways were of steel located so as to minimize the blast effect from a possible nearby bomb burst. Day tanks were provided within the gallery for the operating fuel oil, connection being made for refilling the day tanks from larger underground storage tanks located adjacent to the plant. Slight difficulty was experienced with seepage, a sump pump readily removing the small infiltration of ground water that was experienced.

The actual operation of the underground power plant was successful; such operating difficulties as were experienced were normal troubles encountered in a diesel plant of this kind.

SPA Hydro Program—Summary and Fallacies

Appropriation of $23,000,000 for starting a major program of hydro power development in the Southwest is now being considered by the Congress. This proposal and its implications are of such moment that the editors of ELECTRICAL WORLD feel in duty bound to present it and their reactions to it to the readers of the magazine. The presentation is in two parts. First is a summary of the report presented to the Congress by the Southwestern Power Administration and second, critical comment on the report.

From 70,000 to 2,000,000 Kw.

SCALING THE MAP of its contemplated transmission lines shows that the Southwestern Power Administration proposes an electrical system covering around 300,000 sq. mi. in Arkansas, Oklahoma, Texas, Louisiana, southeastern Kansas and southern Missouri, roughly one tenth the area of continental United States.

According to the report of the Administration on its "Comprehensive Plan of Power Distribution and Sales from Hydroelectric Projects," the proposed system, constructed over a period of 20 years, will be comprised of 1,397,600 kw. of installed hydro capacity intended to be used for carrying peak load, and 770,000 kw. in steam plants for base load supply (Tables I and II). Dependable hydro capacity is stated as 1,234,000 kw. (Table III).

The final transmission grid (Table V) consists of 14,768 mi. of line of 66 kv. and above and includes 3,685,000 kva. of substation capacity. Development of the transmission grid and its annual costs over the 20-year period are shown in Table IV.

Summary of the complete 20-year operation is presented in Table VI. This shows that income is less than outgo for each of the first four years and that the operation does not come out from under accumulated deficit until nine years have passed. Interest on deficit and surplus is calculated at 3 percent for past years and at 1½ percent for current year. At the end of 20 years an accumulated surplus of $43,610,000 is shown.

At the present time the Southwestern Power Administration operates three power plants, Norfork Dam in Arkansas, Denison Dam in Texas, and Grand River Dam (Pensacola) in Oklahoma. Grand River Dam, a state project, was taken over by the federal government during the war emergency and is to be returned to Oklahoma June 30, next. Thus SPA starts its program with two power plants each of which has 35,000 kw. installed. To these are added twelve projects authorized by Congress for flood control and incidental power, and 16 more proposed, making a total of 30.

The report does not specify how many steam plants are contemplated nor their locations and capacities. It

Table I. Hydroelectric Projects in Southwestern Power Administration Program

Project	Installed Initial (1,000 kw.)	Capacity Ultimate (1) (1,000 kw.)	Dependable Capacity (1,000 kw.)	Annual Average (1,000,000 kw.-hr.)	Output Firm	First Cost (2) ($1,000)
CONSTRUCTED PROJECTS						
Norfork	35	70	60	164	108	26,323
Denison	35	105	90	245	141	56,984
Sub-Totals	70	175	150	409	249	83,307
AUTHORIZED PROJECTS						
Fort Gibson	45	45	45	190	90	21,435
Markham Ferry	45	45	40	170	86	15,410
Table Rock	84	84	64	372	329	44,159
Bull Shoals	126	126	122	576	530	38,000
Narrows	17	17	12	25	16	6,470
Blakely Mountain	38	38	32	116	83	10,630
Whitney	22.4	33.6	23	78	29	
Rockland	33	33	22	73	38	
McGee Bend	56	56	38	115	67	
Power Dam "A"	6	6	5	15	9	
Power Dam "B"	8	8	7	48	39	
Canyon(3)					16	
Sub-Totals	480.4	491.6	410	1,778	1,321	
PROPOSED PROJECTS						
Tenkiller	28	28	28	102	60	14,080
Oologah	7	14	12	59	28	14,175
Eufaula	60	90	80	245	118	51,245
Webbers Falls	14	14	14	112	61	25,138
Short Mountain	36	36	36	250	160	37,563
Ozark	18	24	24	176	109	23,101
Dardanelle	30	30	30	240	167	38,774
Wolf Bayou	104	104	104	636	587	
Gilbert	30	30	25	78	60	
Lone Rock	90	90	90	144	99	11,422(4)
Greer's Ferry	78	78	58	131	74	7,179(4)
Blair Creek	60	60	50	126	118	
Doniphan	60	60	60	140	123	
Antlero	18.3	18.3	16	51	21	
Broken Bow	36.3	36.3	31	72	41	
Pine Creek	18.4	18.4	16	29	27	
Sub-Totals	688	731	674	2,591	1,853	
Grand Totals	1,308.4	1,397.6	1,234	4,808	3,423	

Notes: (1) Capacities for which there is foreseeable need. In some instances may go higher.
(2) For all designed purposes, not just for power.
(3) Project being restudied, not included in totals.
(4) Cost for flood control only.

shows simply (Table II) an initial installation of 70,000 kw. in 1946 increasing to 770,000 kw. in 1965, generally in annual additions of 35,000 kw. Investment for steam power is based on a unit cost of $100 per kw., the same unit cost applied through the 20 years. Steam capacity is specified in the report to operate at 80 percent annual plant factor continuously and to have an inclusive cost of 2.8 mills per kw.-hr.

Benefit Value of Hydro

As is done for steam power capacity, annual costs for the transmission grid and its operation are presented in some detail (Table IV). But cost estimates for the hydro portion of the program are not used in the body of the report, although such estimates are developed and presented for the authorized projects in an appendix. Instead the report uses the "benefit value" of hydro energy for addition to steam plant and transmission costs to arrive at total costs. In a power market survey of the southwestern region, the Federal Power Commission concluded "that the energy to be generated from reservoir projects in this area is worth 4.13 mills per kw.-hr. at the high tension buses of the generating stations to replace an equivalent amount of steam generation at load centers." This "benefit value" of 4.13 mills for hydro energy is treated in the report as the cost of that energy. In this connection it is noted that that cost of hydro energy estimated in the appendix is 3.58 mills per kw.-hr.

Rates and Revenues

It is specified that electricity for resale will be sold to public bodies, cooperatives and power companies, in that order of preference, also for direct use to large power customers. Two rate schedules are presented in the report, one for resale customers—60 cents per month per kw. of contract demand plus 3.5 mills per kw.-hr.—and the other for direct-use customers—$2 per month per kw. of contract demand, no energy charge. These schedules are "expected to result in an average revenue of 5 mills per kw.-hr. for all of the power disposed of from the system." Estimated sales and load factors show that expected revenues per kw.-hr. from municipalities and REA cooperatives range from 5.08 to 5.2 mills; from power companies, 5.31 to 5.7; from industrial customers, 4.81 to 5.07 mills.

As to utilizing existing facilities of generating capacity and transmission in the SPA program, the report says:

"It seemed that perhaps the best procedure to be followed in the devel-

Table II. Base Load Steam Capacity Requirements and Costs

Year	Capacity (1,000 kw.)	Investment ($1,000)	Annual Costs ($1,000)					Energy (1,000,000 kw.-hr.)
			Investment	Operation & Maintenance	Fuel	Administrative and General	Total	
1946	70	7,000	470	245	600	50	1,365	490
1947	105	10,500	705	367	900	80	2,052	735
1948	140	14,000	940	490	1,200	110	3,740	980
1949	175	17,500	1,175	612	1,500	140	3,427	1,225
1950	210	21,000	1,410	735	1,800	170	4,115	1,470
1951	245	24,500	1,645	857	2,100	200	4,802	1,715
1952	280	28,000	1,880	980	2,400	230	5,490	1,960
1953	315	31,500	2,115	1,102	2,700	260	6,177	2,205
1954	350	35,000	2,350	1,225	3,000	290	6,865	2,450
1955	385	38,500	2,585	1,347	3,300	320	7,552	2,695
1956	420	42,000	2,820	1,470	3,600	350	8,240	2,940
1957	455	45,500	3,055	1,592	3,900	380	8,927	3,185
1958	490	49,000	3,290	1,715	9,200	410	9,615	3,430
1959	525	52,500	3,525	1,837	4,500	440	10,302	3,675
1960	560	56,000	3,760	1,960	4,800	470	10,990	3,920
1961	595	59,500	3,995	2,082	5,100	500	11,677	4,165
1962	630	63,000	4,230	2,205	5,400	530	12,365	4,410
1963	665	66,500	4,465	2,327	5,700	560	13,052	4,655
1964	700	70,000	4,700	2,450	6,000	590	13,740	4,900
1965	770	77,000	5,170	2,695	6,600	620	15,085	5,390

Table III. Hydro Power and Energy and "Benefit Value"

Year	Dependable Capacity (1,000 kw.)	Average Year (1,000,000 kw.-hr.)	Prime Energy (1,000,000 kw.-hr.)	Benefit Value of Energy ($1,000)
1946	120	409	249	1,690
1947	120	409		1,690
1948	150	409		1,690
1949	320	1,723		7,120
1950	493	1,956	1,419	8,080
1951	527	2,200		9,086
1952	572	2,345		9,685
1953	657	2,770		11,440
1954	675	2,927		12,089
1955	725	2,982	2,144	12,316
1956	773	3,397		14,030
1957	791	3,547		14,649
1958	821	3,768		15,562
1959	895	4,049		16,722
1960	1,050	4,414	3,131	18,223
1961	1,086	4,565		18,853
1962	1,098	4,570		18,874
1963	1,192	4,662		19,254
1964	1,198	4,747		19,564
1965	1,234	4,808	3,423	19,857

Table IV. Transmission Grid Growth and Costs

Year	Percent Complete	Investment ($1,000)	Annual Costs ($1,000)			
			Interest and Amortization	Operation & Maintenance	Administrative And General	Total
1946	20	25,000	1,160	300	200	1,660
1947	40	50,000	2,320	600	400	3,320
1948	48	60,000	2,790	720	480	3,990
1949	52	65,000	3,020	780	520	4,320
1950	55	68,750	3,200	825	550	4,575
1951	58	72,500	3,375	870	580	4,820
1952	61	76,250	3,540	915	610	5,065
1953	64	80,000	3,720	960	640	5,320
1954	67	83,750	3,900	1,005	670	5,575
1955	70	87,500	4,070	1,050	700	5,820
1956	73	91,250	4,250	1,095	730	6,075
1957	76	95,000	4,420	1,140	760	6,320
1958	79	98,750	4,600	1,185	790	6,575
1959	82	102,500	4,770	1,230	820	6,820
1960	85	106,250	4,950	1,275	850	7,075
1961	88	110,000	5,120	1,320	880	7,320
1962	91	113,750	5,300	1,365	910	7,575
1963	94	117,500	5,470	1,410	940	7,820
1964	97	121,250	5,650	1,455	970	8,075
1965	100	125,000	5,810	1,500	1,000	8,310
Totals			81,430	21,000	14,000	116,430

Table V. Final Transmission Grid

Item	Quantity	Cost
154-kv. lines	1,060 miles	$9,540,000
132-kv. lines	2,200 miles	16,500,000
110-kv. lines	358 miles	2,148,000
66-kv. lines	11,150 miles	47,945,000
Substations (110 kv. up)	1,325,000 kv.	16,350,000
Substations (66 kv.)	2,360,000 kva.	32,517,000
Total Costs		125,000,000

opment of a comprehensive plan would be to lay out all of the electric facilities that are required to accomplish the program without regard to existing facilities, and then, as the component parts of the program are developed, to attempt in each case to use the existing facilities if they are adequate for the purpose required, and if arrangements for their use can be made with their owners. The savings resulting by the elimination of any portion of the comprehensive system by the substitution and utilization of existing facilities would offer a fair measure of the price that could be reasonably paid for the utilization of such facilities. This report is based upon carrying out the program in this fashion."

Table VI. Costs, Sales and Revenues

Year	Energy at Source (1,000,000 kw.-hr.)	Energy Sales (1,000,000 kw.-hr.)	Cost at Load Total ($1,000)	Cost at Load per kw.-hr. (Mills)	Revenue Total ($1,000)	Revenue per kw.-hr. (Mills)	Surplus or Deficit ($1,000)	Interest on Surplus or Deficit ($1,000)	Accumulated Surplus or Deficit ($1,000)
1946	899	840	4,715	5.6	4,441	5.3	−274	−4	−278
1947	1,144	1,050	7,062	6.7	5,559	5.3	−1,503	−31	−1,812
1948	1,389	1,285	8,420	5.8	7,004	5.4	−1,416	−75	−3,303
1949	2,948	2,730	14,867	5.5	13,673	5.1	−1,194	−117	−4,614
1950	3,426	3,170	16,770	5.3	16,789	5.3	19	−138	−4,733
1951	3,915	3,612	18,708	5.2	19,163	5.3	455	−135	−4,413
1952	4,305	3,980	20,240	5.1	21,140	5.3	900	−119	−3,632
1953	4,975	4,604	22,937	5.0	24,482	5.2	1,545	−86	−2,173
1954	5,377	4,974	24,529	4.7	26,460	5.3	1,931	−36	−278
1955	5,677	5,254	25,688	4.7	27,935	5.3	2,247	26	1,995
1956	6,337	5,874	28,345	4.8	30,710	5.2	2,365	95	4,455
1957	6,732	6,224	29,896	4.8	32,435	5.2	2,539	172	7,166
1958	7,198	6,656	31,752	4.8	34,735	5.2	2,983	260	10,409
1959	7,724	7,154	33,844	4.8	37,410	5.2	3,566	365	14,340
1960	8,334	7,704	36,288	4.7	40,045	5.2	3,757	486	18,583
1961	8,730	8,084	37,850	4.7	41,275	5.1	3,425	608	22,616
1962	8,980	8,294	38,814	4.7	42,435	5.1	3,621	732	26,969
1963	9,317	8,624	40,126	4.7	44,040	5.1	3,914	868	31,751
1964	9,637	8,924	41,379	4.7	45,610	5.1	4,231	1,015	36,997
1965	10,198	9,444	43,252	4.6	48,230	5.1	4,978	1,185	43,160

Steam Power Would Cost Half as Much

IN GENERAL, engineering reports are of two kinds. One kind includes those whose integrity and competence make them a credit to the engineering profession. The report on the plan of the Southwestern Power Administration is an outstanding example of the other kind.

This report invites criticism in many particulars, some of which will be noted here. Its basic fault lies in its uncritical acceptance of the thesis that water power development, just because it is water power, is always and forever the way to produce electricity at least cost. To such absurd point does the report carry this mistaken idea that its own figures, assumptions and methods can be used to prove the opposite thesis—that if it is advisable to build the proposed system, the hydro plants had better be left out entirely because the contemplated power could be supplied at lower cost and with a much smaller investment by generating all the energy in steam power plants.

In the report the average cost of energy at the load for the 20-year operation is given as 4.86 mills per kw.-hr. This is for hydro power firmed up with steam power. If the system were to include no hydro, but only steam power, the 20-year average cost of energy at the load would be 3.62 mills per kw.-hr., 1.24 mills less. The calculation appears below.

Performing the same calculation for the twentieth year shows that all-steam energy would cost 3.66 mills per kw.-hr. as against 4.6 mills for the hydro-steam combination, a saving of 0.94 mills per kw.-hr. For the first year the cost per kw.-hr. for hydro-steam supply is given as 5.6 mills; for all-steam generation it works out to 3.8 mills, a saving of 1.8 mills.

20-Year Operation

a. Average capacity requirement (Table 19)* ..... 1,129,100 kw.
b. Total generation requirement (Table 19) ..... 117,240,000,000 kw.-hr.
c. 20-year plant factor $\left(\frac{f}{ax876x20}\right)$ 59.3%
d. Total energy requirement at load (Table 19) ..... 108,481,000,000 kw.-hr.
e. Ratio, generation to energy at load $\left(\frac{e}{d}\right)$ 108.1%
f. Cost per kw.-hr. at load (Table 16) ..... 4.86 mills
g. Steam power cost per kw.-hr. at 80% plant factor (Table 16) .... 2.8 mills
h. Steam power cost per kw.-hr. for fuel (Tables 13, 16) ..... 1.23 mills
i. Steam power cost per kw.-hr. at 59.3% plant factor $\left((g-h)\frac{80}{c}+h\right)$ ..... 3.35 mills
j. All-steam cost per kw.-hr. at load (i x e) ..... 3.62 mills
k. Excess of hydro-steam over all-steam cost per kw.-hr. (f-j) ... 1.24 mills

In objection to these conclusions of lesser cost of energy by all-steam generation, it may be said that the figure substituting for unit cost of hydro generation in the report is expressly stated to be an assumed "benefit value" and that cost will actually be much lower. This objection is countered by the obvious consideration that with steam plants located at load centers, transmission costs and losses will be only fractions of what are required by the system proposed in the report, and consequently all-steam operation will actually have lesser costs than are shown by the calculations.

Objection Not Sustained

Moreover, the report itself does not sustain the objection. In an included appendix are set forth costs of hydro generation estimated as such. According to the appendix the tenth year cost per kw.-hr. of hydro power produced at the authorized dams in the program is 3.58 mills. Substituting this figure for the "benefit value" of 4.13 mills and performing the calculation with the figures for the tenth year of the program result in a cost per kw.-hr. at load of 4.58 mills for hydro-steam supply, 0.96 mills higher than the 3.62 mills for all-steam generation.

In further argument against the proposal of the report is the fact that investment in all-steam generation would be much less. Cost of hydro capacity, calculated from data (Table 21) in the appendix, is $238 per kw. Applying this figure to the proposed hydro

* This reference and others designated by Arabic numerals are to tables in the report, not reproduced here.

installation results in an investment of $333,000,000 for that element. To this are added the base load steam plant investment of $77,000,000 and the transmission investment of $125,000,000, a total of $535,000,000.

Hydro Doubles Investment

According to assumption in the report, investment for an all-steam system could not be more than $200,400,000, plus some amount for transmission. Since steam plants would be located at load centers, transmission investment would be only a fraction of that required for the proposed system, say a third. Then the total all-steam system investment would be $242,000,000, less than half of the $535,000,000 for the proposed system.

Thus, using the methods and data of the report itself, it is proved that an all-steam system would require less than half the investment and would produce energy at load at less cost than the combined hydro and steam system proposed in the report.

Points in the report inviting specific criticism are numerous. Here are a couple of them:

An average rate of 5 mills is stated in the text of the report but the tabulated data on sales and revenues do not show a unit revenue as low as that in any year (Table VI). As to revenues by customer groups, it is only in the case of industrial customers that the unit rate goes as low as 5 mills or less. Municipalities, REA cooperatives and power companies all are estimated to pay more than 5 mills, 5.7 mills in one instance.

Can't Afford It

Some 40 percent of total energy sales over the 20-year period is estimated to be made to other power systems at prices ranging from 5.31 to 5.7 mills per kw.-hr. No power system with available capacity of its own can afford to pay more than fuel increment cost for energy from outside and at least some of the output from the proposed development will have to be sold to such systems. This consideration evidently did not enter the thinking of those who prepared the report when they estimated such high revenue from energy sold to other systems.

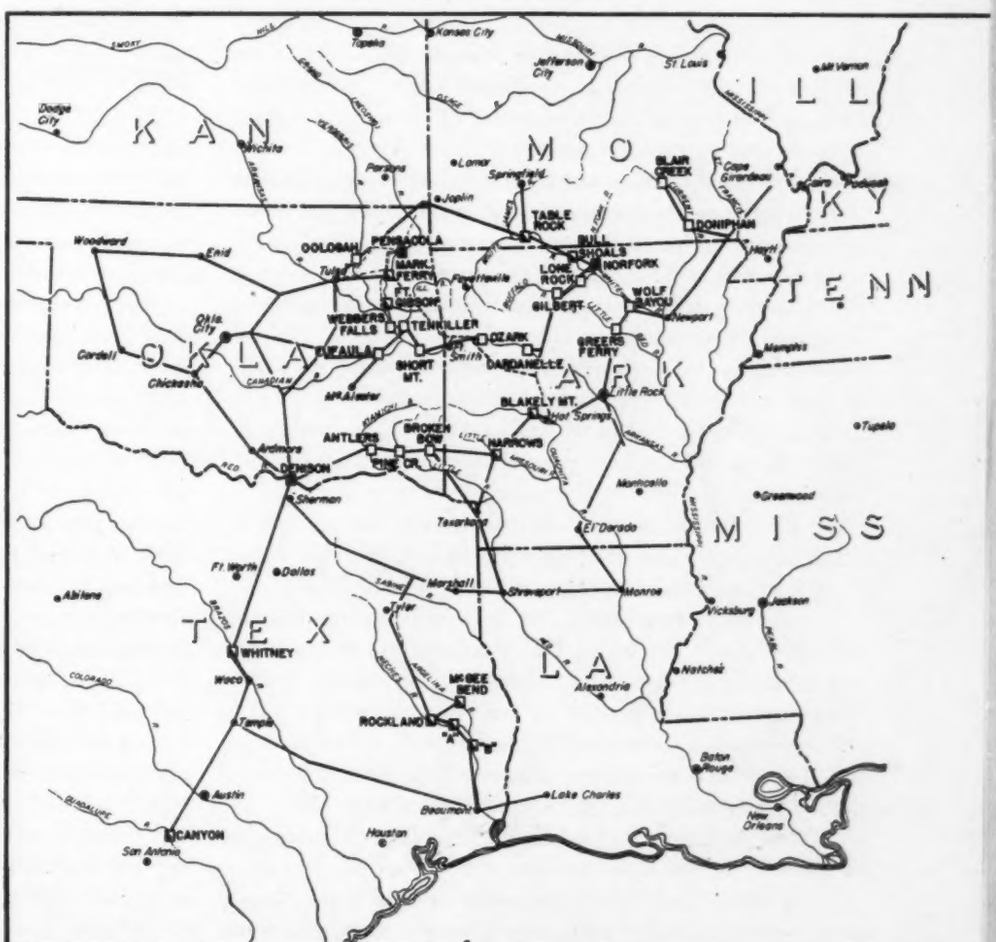
The report states intention to operate the proposed hydro plants to carry peak loads and the whole program is based on that assumption. But for effective flood control, which is the first purpose in building the dams, it is necessary that water in reservoirs be drawn down to specified maximum safe levels as quickly as possible after rises. Energy from water above these specified levels is available at times when the water is there and these times may or may not coincide with occurrences of peak loads on the electricity system. Thus, except for such firm capacity as conditions may permit to be incorporated in design of the hydro projects—and this will be small for the flashy streams of the Southwest—only dump power, not peaking power, will be obtainable.

"Dependable" capacity is defined by the Federal Power Commission as the "capacity that can normally be relied upon to be available for service at the usual time of system peak." Quoting the report, "In all of the projects it is not only possible, but most feasible, to install power capacity greatly in excess of that which can be operated by the regulated stream flow for continuous power production during not only low water years, but even average water years." Despite this statement that by far the major portion of installed capacity will be usable only when water is available (and it must be used then if flood control is not to suffer) the report lists 1,234,000 kw., 88 percent, as dependable capacity out of 1,397,600 kw. installed (Table I).

Another serious criticism of the report is of its bland assumption of construction and equipment costs, many of them of pre-war vintage, remaining constant over a future period of 20 years during which, by every present indication, such costs will rise markedly.

It would be possible to cite additional instances in which the report departs widely from fact and from good engineering sense. But these mentioned here are sufficient, it is believed, to sustain the judgment stated earlier, that this proposal belongs among the other kind of engineering reports.

THE PLAN of the Southwestern Power Administration covers about one tenth the continental area of the nation. It extends over and into six states



Editorials

S. B. WILLIAMS, *Editor*

Productivity and Price of Electrical Goods

THE URGENCY of the need for an upward price adjustment on electrical goods has been spotlighted by the survey on wages and costs appearing in ELECTRICAL WORLD last week. This entire price situation poses both a challenge and a test of good faith for the Economic Stabilizer and OPA. Mr. Bowles has repeatedly stated that metal-consuming industries are most in need of price advances. Convincing support of his thesis is afforded by the experience of electrical manufacturers, whose labor costs are likely to be 75 percent or more higher this year than in 1941 and whose raw material costs will have been upped 30 to 40 percent over the same period.

Underlying the entire wage-price policy of the administration is the basic assumption that productivity increased enormously during the war, thus making higher labor costs possible without increasing prices. There is good reason for doubting the general validity of this assumption, and it certainly is not true for electrical goods. Productivity in shipyards and aircraft plants did leap upward as management and labor became organized and gained experience. But a study of the Department of Labor tells a different story for most other industries that were examined.

No over-all productivity measures exist for electrical manufacturing. The wide variation in number and types of product, many of which are built to individual specification, defy such measures. Yet it is well known among electrical goods producers that productivity of labor in many lines has decreased, rather than advanced. Many firms report that employees in general work more slowly and produce less today than four years ago, although it is hoped that once the current disputes have been resolved, the desire to make up for lost time will change this. It will be some time before output per man hour can rise to pre-war levels, let alone surpass them.

Some types of electrical equipment—turbines are examples—were produced in very large quantities during the war in response to uniform requirements that made standardization possible. Labor cost per unit for such items naturally declined, but the conditions that made possible this decline have largely passed. Labor costs will reflect equipment built to order in small numbers.

This is not to say that the experience of the war will not result in some improvements in organization and technique that can be translated into permanent savings. For some products the gain in efficiency might offset the tremendous rise in wage and raw material costs. But on the average this is not the case. The ELECTRICAL WORLD survey documents the facts as seen by the industry: Price increases will be necessary, but not to the full extent of the rise in costs.

OPA is committed to providing immediate price relief for industries whose profit rate will not equal the minimum base. OPA cannot meet this commitment if it seeks to apply intricate economic analysis to every product produced by electrical manufacturers—one company turns out 200,000 different items. Some common-sense across-the-boards mark-up for different classes of products is required. And decisions must be made soon. Otherwise the electrical manufacturing industry will be penalized not only because it happens to use more labor, directly and indirectly, than many other lines, but also because it is more diverse and complex in its industrial processes.

Recognition of Industrial Electrical Engineers

ELECTRICAL ENGINEERING has come to be a broad and inclusive field reaching all the way from the cells of the pioneers through the big generators of recent years to the more recent radar. Testimony for the embraciveness of the art is not only found in the programs of the American Institute of Electrical Engineers but in the sequence of prominent engineers who have been its presidents. There have been communication engineers, power engineers, consulting engineers, engineers dedicated to design and manufacture of electrical apparatus, and professors devoted to research and pedagogy.

Missing from the cycles in which these representations have appeared has been the industrial operator of the electrical equipment conceived, designed and served by the other types of electrical engineers. It is not so strange that this has been the case because, while industrial use of electrical energy and facilities began almost as soon as there really was an electrical industry, it has only been in the last generation or so that such use has become intensive and diversified.

Now, in the first election to be held since the war and at a time when it is apparent that the whole future economy of this nation is bound up in the productivity of its industry, the omission has been rectified. The Institute is turning for leadership to an outstanding industrial electrical engineer. While it is true that the official nominee for AIEE presidency, Elmer Housley, does operate some siz-

able hydro plants and is employed by a company that makes certain electrical products, his job is essentially that of coordinating electrical energy and electrical equipment with engineering skill to produce one of the country's basic commodities efficiently.

Of greater significance, however, than the recognition of the industrial electrical engineer in the structure of the profession is the opportunity it gives this small but very important group to so translate its objectives that industry may attract the same degree of consideration for its electrical problems as have for years been given to power and communication. Concentrations of power in industry are growing and the consequent problems are bound to become greater and different. Where it used to be enough just to see that the equipment was running, the load has now become so great that engineering and economic decisions are of top importance.

This is an opportunity for industrial electrical men to emerge from the day-by-day practicalities of their mills and take their place in contributing to engineering thought and knowledge.

An Unfair Practice

ACCORDING TO THE RECORD the Commerce Department prepared on October 25, 1945, a "confidential memorandum" alleging that industry in general and the automobile industry in particular could increase wages by 15 percent in 1946 and an additional 10 percent in 1947, without increasing prices, and still make profits far in excess of those in 1941.

This report was made public on November 1. However, in a brief submitted on October 26 by the U.A.W.-C.I.O. in its negotiations with General Motors, sections appear which are identical with sections of the "confidential memorandum." Not only are there identical sections, but, like a Chinese copy, the mistakes of one are faithfully reproduced in the other.

It is not clear whether the Commerce Department adopted the C.I.O.'s figures as its own, or whether the C.I.O. had access to the "confidential memorandum" long before it was made public. But there is no doubt that both had a common source.

Industry attacked the Commerce Department memorandum as being unrealistic, superficial, incomplete, and entirely unreliable. But the C.I.O. used this report as one of its chief supporting arguments for a 30 percent wage increase, not only in the automobile industry but in other industries. The "fact-finding" board in the General Motors case referred to it in recommending the 19½ cent wage increase. That this particular recommendation has strongly influenced national wage levels is beyond question.

Now Secretary Wallace blandly announces that "The projections in the release dated November 1 were not intended, nor should they have been regarded, as official forecasts of costs, prices, or profits for the automobile industry or for industry as a whole . . . "

But the November 1 release said nothing like that. Mr. Wallace did not repudiate the accuracy or authenticity of the report until after the new wage patterns had been set and the General Motors strike had been settled.

In a democracy, the government is supposed to be an instrument of all the people, rather than the instrument of certain pressure groups. It is a distinct disservice to democracy to permit the government to be used to promote the special interests of any group. It is an even more serious offense for any government department to permit one party to a national dispute to have access to confidential government information not available to the other party, or to pass off unreliable, partisan forecasts as official documents.

Leave Nothing to Chance

ONLY A FEW YEARS back the auto tourist found few signposts to guide him; he had to watch for landmarks described in route books and handout maps. But today anyone can travel almost anywhere in the country and find he will not lose his way because there are signs at the otherwise confusing junctions and intersections. For the tourist few minutes are wasted even if not altogether precious.

Has there been corresponding progress in behalf of the system operators or load dispatchers? Up to the beginning of the war there had not been and perhaps there did not need to be—they knew their moves so positively that they could perform them reliably in any emergency and without error.

Circumstances have changed and so have a considerable number of the system and station operators. It is doubtful if the new men have had opportunity to familiarize themselves with the details to a degree that assures correct operations when things happen abnormally and fast. Certainly there were few operators capable of taking the travelling assignment when the work-week was shortened. They were usually the older, more experienced employees and some of them are soon to be succeeded by others and that means more training.

All these factors seem to point to the logic of following in the footsteps of the highway authorities in principles and in the footsteps of the Navy in detail. That entails labeling every switch and breaker, not only with its number and circuit identification, but also with terse instructions covering what moves to make in sequence under ruling conditions of emergency.

That would appear far better than committing these details to a book or, worse, to mere memory. Having the instructions in plain and legible form on each switch would place them where they would never be inaccessible or hard to find in a hurry. It would also permit making the instruction books less detailed and more instructive as to basic principles of switching, the objectives of certain correlated actions and the reasons why other actions could be detrimental or even destructive.

WASHINGTON COMMENT

By R. N. LARKIN, Washington Correspondent

How REA Justifies Buying Properties

THE 1946 MODEL of a policy which the Rural Electrification Administration has nursed to fruition since the Securities and Exchange Commission began forcing electric properties onto the market under Section 11 (b) (1) of the Holding Company Act became public recently.

REA for years has followed a successful, if sometimes stormy, course in acquiring the facilities of privately owned electric systems. There was considerable question as to whether its authorization "to make loans . . . for the purpose of financing the construction and operation of generating plants, electric transmission and distribution lines or systems for the furnishing of electric energy to persons in rural areas who are not receiving central station service. . ." (REA Act, Sec. 4) constituted authorization to purchase existing systems. That argument, whatever its legalistic outcome might have been, was settled by the fact that while no such specific authorization was included, neither was acquisition of existing systems prohibited, and the act has been administered during years when the national administration has not only been able successfully to assume implied jurisdiction, but when it has also been able to keep getting reelected.

Above the Statutory Limit

A more readily defended protest against the acquisition policy has been that against the acquisition, under REA financing, of existing systems located outside what the REA Act describes as rural area. The act defines rural area as "any area of the United States not included within the boundaries of any city, village or borough having a population in excess of 1,500 inhabitants, and such term shall be deemed to include both the farm and non-farm population thereof. . ." (REA Act, Sec. 13.)

According to Administrator Claude R. Wickard, REA has acquired systems in 28 municipalities whose population is greater than 1,500. The agency supports this course, and with all the success it could wish, by citing an opinion by one of its attorneys which holds that acquisitions may be made, even in municipalities above the statutory limit, where the acquisition is the only feasible means of bringing service to persons in unserved areas. REA cites an opinion of the Comptroller General which confirms the REA opinion and which lays down as a rule of thumb the proposition that the money spent in acquiring existing facilities should not exceed that spent to bring service to unserved people reachable by REA solely as a result of the acquisition. Further in support of its practice, REA cites several Congressional debates when the issue was before Congress and in which it was resolved in REA's favor. Finally, REA says, with convincing fervor if not with flawless logic, that "we don't do it very often."

Required to Earn and Serve

The new REA position is that as rural electrification moves into successively thinner territory, cooperatives must be more and more free to incorporate municipalities into their systems so as to obtain the concentration of load which will enable farmers in sparsely settled areas to be served at all. From REA's point of view, such a position is tenable (even though it assumes eventualities which may not take place) and it has two facts to substantiate it, despite the existence of the 1,500 population limitation. First is the statutory requirement that REA loans be made only where there is sound reason to believe that they will be self-liquidating. Second is the insistence of Congressional leaders that REA operate so it will bring electricity service to all possible people.

It should be understood that a Congressman's definition of the term "all possible people" is apt to extend well beyond the definition an operating utility executive might apply. A utility executive is concerned with earnings. Congressional leaders are concerned with votes. The methods used for each purpose may not be mutually exclusive, but they are prone to diverge, and their conflicts are not always readily resolved. The industry may or may not choose to continue its efforts to demonstrate just why it may now be impractical for anyone to attempt electrification of areas falling short of its own honest standards of accessibility. It should, however, recognize that the demand on Congress for complete rural electrification, and the desire on the part of an elected official to provide complete rural electrification, are equally honest.

Quod Erat Demonstrandum

It is perhaps unfortunate that a pat formula can not be written into the REA law whereby anyone with a reading knowledge of the language would be able to decide readily and finally and liberally that a proposed REA program did or did not meet the terms and the purposes of the act and therefore is or is not allowable. No one has yet presented one which could begin to get full agreement from both parties at issue. The Arkansas Power and Light Co. insists that energy sold co-ops under a special, low wholesale rate shall not be used by co-ops to undersell the company with its existing customers. Wickard argues that REA must be free to serve where the rendering of service is the only way in which service can be rendered at all to still other unserved persons.

"It is absolutely necessary and essential for you to have the power to take over some of these smaller cities in order to extend your lines in the rural communities, and if you are restricted on that basis, it means that there will be many communities in this country, especially in the west and south, which will never get electricity; is that not true?" Wickard was asked.

"I think that is right," Wickard replied.

This exchange makes no allowance for industry participation, but right or wrong, logical or not, it spells out the new acquisition policy of REA.

NEWS OF THE WEEK

Diluted Atomic Power Use Suggestion for Generation

State Department Releases Report on International Control of Atomic Energy—Atomic Development Authority Representing All Nations Proposed—Denatured Plutonium Would be Used to Generate Electricity

An international body representing all nations—the Atomic Development Authority—would be the largest operator of fuel-electric plants in the world and would produce at least half of all energy developed through the use of atomic power.

Production of electric power through the use of nuclear reactors using denatured plutonium and ranging in capacity from 100,000 to 1,000,000,000 kw. may safely be left to private initiative provided adequate international control of atomic energy exists.

"No significant limitations of this power development, either in the availability or in the cost of the fundamental active materials" is seen.

Production of electric power through the use of the uranium-graphite pile developed by the Manhattan District, itself a producer of plutonium, is dangerous and should only be permitted under ownership and operation of an international body.

These are the outstanding facts for the electric power industry contained in a report on the international control of atomic energy released this week by the State Department for whose atomic energy committee the report was prepared by a board of consultants headed by Chairman David E. Lilienthal of the Tennessee Valley Authority.

First lay knowledge of the possibility of so adulterating plutonium, a fissionable "by-product" of the uranium-graphite pile, as to render it useful for non-explosive applications while removing its explosive properties, came from the report.

Described as "not a final plan," but rather as a "place to begin a foundation on which to build," the report called for the organization of an international atom control and ownership body which would,

1. Own all known sources of uranium and thorium.
2. Conduct all mining and preparation of these minerals.
3. Conduct all preparation of these metals.
4. Operate all piles producing fissionable materials.
5. Denature, stockpile, and lease all fissionable products.
6. Maintain adequate supervisory, inspection, and auditing experts to assure compliance with its regulations.
7. Maintain itself through research and development as the foremost source of information on atomic energy in the world.

Having established an international body to own and control the sources of atomic energy, the report called for utmost participation in "safe" operations in this field by national and private interests so that an international monopoly might be averted and broadest benefits obtained. Such activity would be under general supervision of the international body.

The committee emphasized its belief that practices it considers "safe" need not be solely performed by the atomic development authority.

"If it were necessary, in such a scheme of safeguards, to vest in an international agency a total monopoly as to all aspects of atomic energy," the report declared, "disadvantages would arise so great as conceivably to make the prospect of effective internationalization itself beyond realization. Such an over-all grant of exclusive right to develop, operate and utilize, conferred upon an international agency, would change many of the industrial and economic practices of this country, for example, and would change them quite disadvantageously.

No Need for Monopoly

"Such a complete international monopoly would be hard to live under . . . this problem need not arise. For there are important areas in the field of atomic energy where there is no need for an international monolopy, and where work may and should be open not exclusively to the international organization, but to national institutions in quite a free manner . . .

"In our view, any activity is dangerous which offers a solution either in the actual fact of its physical installation, or by subtle alterations thereof, to one of the three major problems of making atomic weapons,

"1 The provision of raw materials.

"2. The production in suitable quality and quantity of the fissionable materials plutonium and U-235, and

"3. The use of these materials for the making of atomic weapons."

"Regarding the possibility of "denaturing" plutonium for safe operation of atomic electric plants, the committee asserted,

"A further point which will prove important in establishing the criteria for the safety or danger of an operation in regard to U-235 and plutonium is that such denatured materials do not readily lend themselves to the making of atomic explosives, but they can still be used with no essential loss of effectiveness for the peaceful applications of atomic energy. They can be used in reactors for the generation of power or in reactors

useful in research and in the production of radioactive tracers. It is important to understand the sense in which denaturing renders material safer. In the first place, it will make these materials unusable by any method we now know for effective atomic explosives unless steps are taken to remove the denaturants. In the second place, the development of more ingenious methods in the field of atomic explosives which might make this material effectively usable is not only dubious, but is certainly not possible without a very major scientific and technical effort.

"It is possible, for both U-235 and for plutonium, to remove the denaturant, but doing so calls for rather complex installations which, though not of the scale of those at Oak Ridge and Hanford, nevertheless will require a large effort, and above all, scientific and engineering skill of an appreciable order, for their development. It is not without importance to bear in mind that, although as the art now stands, denatured materials are unsuitable for bomb manufacture, developments which do not appear to be in principle impossible might alter the situation. This is a good example of the need for constant reconsideration of the dividing line between what is safe and what is dangerous.

"We would, however, propose as a criterion that installations using material both denatured and insufficient in quantity for the manufacture of bombs could be regarded as safe, provided the installations did not themselves make large quantities of suitable material. With some safeguards in the form of supervision, installations in which the amounts of material are small, or in which the material is denatured, might also be regarded as safe; but installations using or making large amounts of material not denatured, or not necessarily denatured, we would call dangerous.

Other Option Possible

"More marginal from the standpoint of safety, but nevertheless important, is another case of an operation we would regard as safe. This is the development of power from the fission of denatured U-235 and plutonium in high power-level reactors. Such power reactors might operate in the range from 100,000 to 1,000,000,000 kw. If these fissionable materials are used in installations where there is no additional uranium or thorium, they will not produce further fissionable materials. The operation of the reactors will use up the material. If the reactors are suitably designed, a minimum of supervision should make it possible to prevent the substitution of uranium and thorium for the interstructure of the materials of the reactors.

"In order to convert the material invested in such reactors to atomic weapons, it would be necessary to close down the reactors; to decontaminate the fissionable material of its radioactive technical undertaking, from its denaturant; and to establish plants for making atomic weapons. In view of the limited amount of material needed for such a power reactor and of the spectacular character and difficulty of the steps necessary to divert it, we would regard such power reactors as safe provided there were a minimum of reasonable supervision of their design, construction and operation. If the material from one such reactor, of a size of practical interest for power production, were diverted, it might be a matter of some two or three years before it could be used to make a small number of atomic weapons.

"We attach some importance to reactors of this type because they make it possible in large measure to open up the field of atomic power production to private or national enterprise," the report asserted. "It is, in this connection, important to note that the materials required in these reactors cannot themselves be produced in installations which we could regard as safe. It is, furthermore, important to note that for every kilowatt generated in safe reactors, about 1 kw. must be generated in dangerous ones in which the material was manufactured. Thus, if atomic power is in fact developed on a large scale, about half of it will inevitably be an international monopoly, and about a half might be available for competitive exploitation.

"That is to say, the primary production plant necessary to produce the materials required to construct safe power plants will, in that process of production, produce large amounts of power as a by-product. It is, furthermore, clear that the stockpiling of appreciable quantities of fissionable material suitably denatured must precede the development of these safe power reactors. We think it fortunate that the actual operation of such reactors will have to await the production of these essential materials so that there will be time for further study of means by which they may be supervised and their safety ensured."

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Utility Training Salesmen

Envisioning needs of retail electric appliance salesmen with respect to psychologized knowledge of selling procedures to customers, Utah Power & Light Company has begun a training program for the various sales representatives of the company's divisions, made up of lectures and sound movies at a series of meetings.

Holding Company Act Defended by Purcell

SEC Chairman Opposes Revisions Suggested by Industry as Destroying Regulatory Effectiveness

Chairman Ganson Purcell, of the Securities and Exchange Commission, asserted that the changes in the Holding Company Act suggested by industry and other witnesses before the Boren subcommittee investigating administration of the act "reach substantially every provision in the statute and that their combined efforts would be to remove or restrict every important regulatory provision of the statute and substantially to destroy its effectiveness as a regulatory measure."

Purcell's testimony came as the Public Utilities Subcommittee of the House Interstate Commerce Committee neared the end of its investigation which began last July. SEC witnesses were to testify this week, after which it is possible that Federal Power Commission Chairman Leland Olds may be recalled. Beyond that, nothing is scheduled.

Purcell urged the committee to consider the sum of the amendments proposed by holding and operating company people.

"The industry witnesses," he asserted, "have proposed fundamental and far-reaching amendments—no less so because they may have been presented under the guise of minor verbal changes or with disclaimers of drastic intent.

"I do not know to what extent the presentation of the various industry witnesses has resulted from concerted planning through industry-wide organizations, such as the National Association of Electric Companies," Purcell went on. "But I think it is interesting to note the following phenomenon which may be a mere coincidence. Practically every industry witness stated that he was not proposing fundamental or numerous changes in the law. Yet, when we fit together, like pieces in a jigsaw puzzle, the two or three suggestions coming from each of the numerous witnesses, under the guise of "clarifying amendments," we find that altogether they reach substantially every provision in the statute and that their combined effect would be to remove or restrict every important regulatory provision of the statute and substantially to destroy its effectiveness as a regulatory measure."

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25-Year Franchise Voted

Kiron, Iowa, has voted the Iowa Public Service Co. a 25-year franchise.

Court Upholds TVA's Condemnation Power

Supreme Court Decision Unanimous but Justices Disagree on Extent of Judicial Review of Such Seizures

The Supreme Court ruled unanimously this week that the Tennessee Valley Authority has the power to condemn land and to enter into agreements with various federal and state governmental subdivisions by way of settling resulting claims for compensation, but three members expressed varying views regarding the extent to which such condemnations are subject to judicial review.

At issue was a circuit court affirmation of a district court's dismissal of condemnation petitions filed by TVA against six holdings, access to which was cut off when the Fontana dam reservoir was filled. Considering it uneconomic to replace the only road into the area, TVA agreed to settle with state and county governments and to take all the land, transferring what it did not need to the national park service. Six of the landholders chose not to sell and won dismissal of the condemnation petitions.

In its brief, TVA argued that its decision was authorized under the act and that it could not be set aside by the court. Mr. Justice Black contended in the majority opinion that the district court had construed the act narrowly in dismissing the petitions, and cited a section requiring that it be construed liberally. He added that "TVA has proceeded in complete accord with the Congressional policy embodied in the act." None of the intricacies of the settlement hedged TVA's authority to condemn, he added.

Concurring Opinions Vary

In a concurring opinion in which the Chief Justice joined, Mr. Justice Reed agreed with TVA's broad powers to condemn, but he argued against a position he saw implied by the majority opinion, that no judicial review is available of a decision taken by TVA as necessary to the conduct of its duties. He asserted that ". . . The Constitutional doctrine of separation of powers would be unduly restricted if an administrative agency could invoke a so-called political power so as to immunize its action against judical examination in contests between the agency and the citizen."

Mr. Justice Frankfurter, in another concurring opinion, failed to read into the majority opinion what Mr. Justice Reed saw there, but he recognized the right of judicial review of administrative action.

WISCONSIN VIEWPOINT—C. W. Eppard, general manager of the Dairyland Power Cooperative, Genoa, Wis., takes the floor at the recent convention of the National Rural Electric Cooperative Association to give the delegates the Wisconsin viewpoint on the current topic

Electric Bills Estimated on Appliance Consumption

The Modesto Irrigation District which furnishes electricity in Modesto, Calif., and the surrounding area has changed its system of billing customers for whom it has been unable to obtain meters from a "flat" rate to one that is based upon the number of appliances used, C. E. Plummer, chief engineer, has announced. The scale is similar to that being used by two utilities in the Southeast (ELECTRICAL WORLD, March 16, Page 104).

The following averages, monthly consumption in kw.-hr., are used for a family of two or three in the average small house: lights, 25; flat iron, 6; radio, 10; refrigerator, 35; washer, 3; ironer, 85; range, 85; and water heater, 250.

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Breach of Contract Suit Ends in $91,000 Settlement

A $91,000 claim has been paid on a surety bond to Bonneville Power Administration and other firms for the failure of Enterprise Electric Co., Maryland, to fulfill a transmission line building contract.

The federal court settlement, made by Seaboard Surety Co., was distributed among 120 persons and firms through the contracting firm's defaulting on line construction between Covington, Wash., and Grand Coulee Dam. Of the sum, the largest share, $23,600, went to Bonneville administration on basis of laborer wage claims entered.

Pennsylvania Co-ops Not Subject to P.U.C.

Pennsylvania cooperative associations are not subject to jurisdiction of the Public Utility Commission, it was ruled on March 14 in an opinion handed down in Dauphin County Court at Harrisburg by Judge Karl E. Richards, who declared it was the court's duty "to interpret and apply the law and not to usurp legislative functions."

In line with its opinion, the court dismissed the suit of the Pennsylvania Electric Co., Johnstown, which sought to prevent issuance by State Commonwealth Secretary Charles M. Morrison of a charter to the Allegheny Electric Cooperative, Inc., of Parker's Landing.

The electric company, which now serves in territory where the co-op intends to serve, sought to restrain the Department of State from issuing a certificate of incorporation to the cooperative until the P.U.C. had found it "is necessary for the service, accommodation, convenience or safety of the public." It contended that the co-op must first obtain P.U.C. permission before it can apply for a charter.

Judge Richards disagreed with this argument, ruling there was no conflict between the Public Utility Law and the Electric Cooperative Corporation Act.

"Questions relating to legislative policy are not for the courts to decide," the judge said in his opinion. "The power conferred upon cooperatives, such as eminent domain, the exemption of cooperatives from taxation, the effect upon existing electric utilities, the duplication of facilities and similar matters are purely questions of legislative policy. The duty of the court is to interpret and apply the law and not to usurp legislative functions."

The cooperative was formed from several cooperatives which bought power from the Pennsylvania Electric Co. The cooperative proposed to construct a generating plant and transmission lines to serve seven rural electric cooperatives scattered through western Pennsylvania.

The electric company complained that would duplicate its and other utilities' facilities, would serve some of Pennsylvania Electric's customers, "cause immediate and irreparable damage to the plaintiff and deprive the Commonwealth of a tax which it would otherwise receive."

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Municipal System Beaten

Valdosta, Ga., recently voted against the purchase of an electrical distribution system for operation by the city.

INSIDE INFORMATION—Officers, department heads, and supervisory personnel of the Ohio Public Service Co. attend Twelfth Annual Sales Conference in Cleveland. Ranking company officials were speakers at the two-day conference designed to give employees a clear picture of problems confronting the industry and of the plans of the utility for the coming year

Western Wholesalers Hold Winter Meeting

Business managed utilities will find it increasingly difficult to compete with large tax-free subsidized government power operations, warned Kinsey M. Robinson, president, Washington Water Power Co., Spokane, in speaking before a session with utility executives at the winter meeting of the Pacific Division, National Electrical Wholesalers' Association, at Fresno, Calif., March 14-16. It is a challenge to management to win public confidence and good will with the lowest possible rates and the best possible service, he said.

In presiding over the session, R. E. Fisher, vice-president, Pacific Gas & Electric Co., said that common problems of the wholesalers and utilities are increasing taxes, opposition to further regimentation and regulation, the preservation of free enterprise and the suppression of further inroads on legitimate business by tax-evading cooperatives.

Summarizing the Far Western construction market, George C. Tenney, editor, *Electrical West*, said that utilities have budgeted $147,000,000 for 1946, with federal power appropriations increasing the total to more than $200,000,000. Principal items include $65,000,000 for distribution, $25,000,000 in REA projects, and $27,000,000 for maintenance.

Ability to sell a potential electrical appliance market of $330,000,000 during 1946 in the eleven Western states is dependent upon availability of appliances, said O. R. Doerr, sales manager, Pacific Gas & Electric Co. The number of dealers attracted to the business in the hope of quick and easy profit is a disturbing element. He showed that with the 10,032 existing dealers in the West and the average volume to be expected, the majority of dealers can be expected to lose money on margins permitted by OPA. Other speakers included R. C. McFadden, Southern California Edison Co.; Harvey Edmund, Coast Counties Gas & Electric Co.; William Fleming, California Electric Power Co.; and R. E. Robertson, Frigidaire. Charles W. Goodwin, San Francisco district manager, General Electric Supply Co., was elected chairman of the division, succeeding J. P. Carson, San Francisco manager of Graybar Electric Co.

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Bonneville Power-Union Pact Called First of Kind

The Bonneville Power regional advisory council and the Columbia power trades council have reached an agreement, establishing Bonneville's pay scale for workers, which is said by union spokesmen to be the first to be made between any union and the government.

The satisfactory settlement reached by the representatives of 16 electrical unions and five members of the Bonneville council provided for overtime remuneration over eight hours in any day, overtime for Sundays and holidays, and emergency "block pay." The contract terms also included promise by the government to pay for required physical exams, social security benefits, and employment compensation benefits to workers.

Simultaneously, it was agreed that any jurisdictional disputes would be settled within the trades council, and that any future disputes with the government would be arbitrated without work stoppages.

Nebraska Power Co. Sale Brings Another Law Suit

Another law suit has been added to the maze of litigation which followed the sale of the Nebraska Power Co. to the Omaha Electric Committee, a non-profit group intended as the vehicle to convey the once privately owned utility to public ownership.

Attorneys William Ritchie and G. H. Seig, representing Omaha Ice & Cold Storage, Inc., have filed a complaint in the Federal Court at Omaha asking that the purchase of Nebraska Power Co. common stock by the O.E.C. be cancelled.

The complaint asks the court to halt any further payments by Nebraska Power to the Loup River Public Power District for Loup's aid in financing the transaction. Money already paid Loup should be returned, the complaint asserts. It also asks the court to prevent transfer of the Nebraska Power properties to Loup, which, it asserts, is the ultimate goal of O.E.C.

Furthermore the complaint charges that O. E. C. has refused to negotiate with the new Omaha Public Power District except at the price paid for the properties plus fees and commissions.

The Cold Storage Co. filed suit as a power user, and Loup, O.E.C., and Nebraska Power are named as defendants.

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City System Abandoned

A ten-year franchise has been granted the Oklahoma Power & Water Co. by Kaw City, Okla., which has abandoned its municipal plant and system. The property will be invoiced for whatever disposal can be made of it.

Utility Restrictions Slight under CPA-1

Construction of Lines, Substations and Plants Will Not Be Greatly Impeded — Office Building Limited

Electric utilities won almost complete exemption from the restrictions of the Civilian Production Administration's Housing Program Order No. 1, which was issued this week, halting new construction without specific authorization. Under the order, utilities would face heavy restrictions in starting new office buildings but would not be greatly impeded in construction of lines, generating plants, and substations.

The order provides that after March 26, no one shall construct, repair, add to, alter, improve or convert any public or private structure, or install or relocate therein any fixture or mechanical equipment. The term "structure" does not include utility facilities, except for buildings, which provide electric, gas, sewerage, water, central steam heating, telephone, or telegraph services including power lines. The term "fixture and mechanical equipment" does not include power generating or transmitting equipment such as boilers, generators, transformers, and the like.

Specific Authorization Needed

CPA officials explained that while any building costing more than $15,000 required to house utility facilities would require specific authorization, such authorization would readily be forthcoming on a showing that the facilities are necessary. This represents a distinct, if minor, curtailment of the exemption afforded utility facilities.

The order does not apply to work begun before March 26, but this exemption applies only to the particular building or other structure so begun. The exemption does not apply even though a proposed building may be closely related to that begun before March 26.

The order contains a $15,000 exemption for utility structures, public or private, which provides any of the utility services mentioned previously. This figure includes the cost of the entire construction job as estimated at the time construction was begun. It includes the cost of new fixtures and mechanical equipment but not the cost of previously used fixtures, mechanical equipment and materials. No job may be subdivided to come within this exemption.

The restrictions of the order do not apply to maintenance and repair work in structures covered by the $15,000 exemption. Maintenance means the minimum upkeep necessary to keep the structure in sound working condition. Neither term includes the improvement of any structure by replacing material which is still usable. No maintenance or repair work which is capitalized by the person doing it may be performed under this exemption. Alterations to a structure covered by the $15,000 exemption, including those incidental to installation of equipment, are not exempted.

Restrictions of the order do not apply to the minimum work necessary to prevent more damage to a building damaged by flood, fire, tornado, or similar disaster. This does not include restoration to pre-disaster condition.

Persons wishing to begin work prohibited by the order may apply for authorization to do so. Utility construction should be applied for on form CPA 4423 filed with the appropriate construction field office of the CPA. Applications will be reviewed to determine the extent to which the construction they propose would interfere with the veterans' housing program. Other criteria for authorization will include essentiality of the proposal to the housing program, the elimination of a bottleneck to reconversion, public health and safety, and unusual or extreme hardship.

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Will Construct Substations

Cleveland Electric Illuminating Co. has announced a $9,000,000 construction program for 1946. Most of the money will be used for new substations.

Westinghouse Strike Settlement Flounders

Labor Department Officials Study Report on Situation Made by Federal Mediators Who Withdrew

No recommendation for the settlement of the Westinghouse strike nor none for further Federal action in the case was the substance of the report delivered to Secretary of Labor Lewis B. Schwellenbach by the mediators, a representative of ELECTRICAL WORLD learned late this week. No developments are expected until labor officials in Washington have had a chance to study the report. The mediators stated publication of the report would be up to Mr. Schwellenbach.

Negotiations between the company and the United Electrical, Radio & Machine Workers union have been broken off since Wednesday, March 20. The Federal mediators have withdrawn and prepared the summarizing report for the Labor Department.

After the mediators had withdrawn, Gwilym A. Price, president of Westinghouse Electric Corp., declared that the company's wage offer puts "Westinghouse wages so far out in front of its competitors that the company cannot make a higher offer."

Under its offer, men employees would receive $1.46 an hour on the average. Women employees on women's jobs would not only receive the 17½ cents per hour increase for men but would

WESTINGHOUSE AND STANLEY HONORED—Governor Maurice J. Tobin unveils monument at Great Barrington, Mass., where 60 years ago George Westinghouse and William Stanley launched what is believed to be America's first town lighting system served by alternating current. The monument was donated by Westinghouse Electric Corp., and Frank L. Nason of that corporation made the principal address

receive an additional four or five cents an hour on an average to raise their rates toward equality with men's rates, Mr. Price pointed out.

"To date, each workman has lost $480 on the average," he added, "and each workman will lose an average of approximately $50 each week that the strike is further prolonged." He also stated, "If the employees were free to express their own feeling—judging by letters, telephone calls, and other comments which management has received —the employees would be marching as an expression of approval and as a protest against further coercion by union leaders.

"The company has grave doubts that it was justified in making the liberal offer which it already has made. Certainly it cannot make a higher offer."

W. G. Marshall, vice president of industrial relations, stated, "Approximately 40 percent of the non-striking salaried employees are now employed at their regular or temporary locations." The engineering staff is included in this 40 percent and they have been "carrying on" in improvised quarters. Mr. Price paid the engineering profession a high compliment by stating, "Our engineers have been working under the most trying conditions and, in a typical 'old American way,' have been doing surprisingly well."

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Alabama Court Decision Clears Way for '44 Refund

An attempt by the H. W. Smith Lumber Co. of Jackson, Ala., to halt a Public Service Commission order requiring the Alabama Power Co. to refund to its residential and municipal street lighting customers the amount of their December, 1944, bills has ended with a ruling of the Alabama Supreme Court denying the lumber company the right to intervene.

Previously the Montgomery Circuit Court had ruled against the lumber company. The validity of the commission's order itself was not dealt with in the proceedings.

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Sabotage Halts Service

Deliberate damage to transformers of the Lower Colorado River Authority is blamed for a series of interruptions which has halted service recently in several Texas communities. Max Starcke, general manager, said that oil had been drained from substation transformers. In some cases, the tampering was discovered before any damage was done, but in others, equipment was badly damaged.

PR-28 Revisions of CPA Govern CC Regulations

The Civilian Production Administration has revised its Priorities Regulation-28 regarding the regulations under which CC ratings are issued.

The revision allows the granting of CC ratings for materials to be incorporated in essential construction, such as a dwelling granted a priority under PR-33. CC ratings also may issue for construction, repair or alteration of a house to be occupied by a World War II veteran when the veteran makes application.

For manufacturers, CPA defined the PR-28 "minimum economic rate" of production up to which manufacturers may expect CPA assistance. It means the rate of operation at which a plant as a whole must produce to avoid incurring financial loss. It pays no heed to any particular product of a plant making more than one item. If plants are operating at less than capacity without financial loss, their minimum economic rate will not be considered to be higher than the current output rate, even though some normal products may not be in production.

Most manufacturers will receive CPA assistance only until they reach their minimum economic rate, but those making commodities which have formally been designated by CPA as being in critically short supply may receive assistance beyond their minimum economic rates.

Other changes in PR-28 include a statement that CPA will not assign ratings for more than a 60-day supply of production materials and operating supplies although further applications may be made later and a ruling that preference ratings will not be assigned for items to be resold with change in form.

MEETINGS

Pennsylvania Electric Association—Street lighting committee, Harrisburg, Pa., April 10; R. M. Hoot, chairman, Philadelphia Electric Co., Philadelphia, Pa. Residential committee, Harrisburg, Pa., April 22-23. C. M. England, chairman, Pennsylvania Power Co., New Castle, Pa. Commercial committee, New Castle, Pa., May 23; A. G. Garrigues, chairman, Philadelphia Electric Co., Philadelphia, Pa. Rural committee, State College, Pa., May 23-24; W. H. Ferguson, chairman, Duquesne Light Co., Pittsburgh, Pa.

Maryland Utilities Association—Annual conference, Lord Baltimore Hotel, Baltimore, Md., April 12. Association office, Lexington Bldg., Baltimore 1, Md.

Northwest Electric Light & Power Association—Business Development Section, Portland, Ore., April 15-17; Engineering Section, Seattle, Wash., April 24-26. Berkeley Snow, managing director, 418 Spalding Bldg., Portland 4, Ore.

Edison Electric Institute—Engineering committees, Edgewater Beach Hotel, Chicago, Ill., May 6-7. Col. H. S. Bennion, managing director, 420 Lexington Ave., New York 17, N. Y.

Previously Listed

American Society of Mechanical Engineers—Spring meeting, Hotel Patten and Reid House, Chattanooga, Tenn., April 1-3; semi-annual meeting, Book Cadillac and Statler hotels, Detroit, Mich., June 17-20. Ernest Hartford, executive assistant secretary, 29 W. 39th St., New York 18, N. Y.

Edison Electric Institute—General sales conference, Edgewater Beach Hotel, Chicago, Ill., April 2-4; annual convention, Waldorf Astoria Hotel, New York, N. Y., June 3-5. Col. H. S. Bennion, managing director, 420 Lexington Ave., New York 17, N. Y.

Midwest Power Conference—Annual meeting, Palmer House, Chicago, Ill., April 3-5. S. E. Winston, director, Illinois Institute of Technology, Chicago 16, Ill.

National Electrical Manufacturers Association—Spring meeting, Palmer House, Chicago, Ill., week of April 8; special sections meetings, The Homestead, Hot Springs, Va., June 17-19. W. J. Donald, managing director, 155 E. 44th St., New York 17, N. Y.

Missouri Valley Electric Association—Engineering conference, Hotel Continental, Kansas City, Mo., April 10-12. I. D. Pettegrew, director, 1004 Baltimore St., Kansas City 6, Mo.

Electrochemical Society—Spring meeting, Tutwiler Hotel, Birmingham, Ala., April 10-13. Colin G. Fink, secretary, Columbia University, 3000 Broadway, New York 27, N. Y.

Pennsylvania Electric Association—Industrial sales conference, Hotel Hershey, Hershey, Pa., April 11-12; G. E. Duerr, chairman, West Penn Power Co., Pittsburgh, Pa. Engineering Section all committees, Penn Harris Hotel, Harrisburg, Pa., May 28-29; E. B. Shew, chairman, Philadelphia Electric Co., 900 Sansom St., Philadelphia 5, Pa.

National Electrical Wholesalers Association—Annual convention, Stevens Hotel, Chicago, Ill., April 21-25. C. G. Pyle, managing director, 500 Fifth Ave., New York, N. Y.

Society of the Plastics Industry—National plastics exposition, Grand Central Palace, New York, N. Y., April 22-27. John Wetherby, secretary, 295 Madison Ave., New York 17, N. Y.

American Institute of Electrical Engineers—Northeastern district, Buffalo, N. Y., April 24-25; summer convention, Hotel Statler, Detroit, Mich., June 24-28. H. H. Henline, secretary, 33 W. 39th St., New York 18, N. Y.

Southeastern Electric Exchange—Annual conference, Edgewater Gulf Hotel, Edgewater Park, Miss., April 24-26. J. W. Talley, executive secretary, 303 Haas-Howell Bldg., Atlanta 1, Ga.

International Lighting Exposition—Stevens Hotel, Chicago, Ill., April 25-30. A. B. Coffman, manager, 111 W. Jackson Bldg., Chicago 54, Ill.

National Association of Corrosion Engineers—Annual convention, President Hotel, Kansas City, Mo., May 7-9. Elton Sterrett, executive secretary, 318 Southern Standard Bldg., Houston 2, Texas.

Great Lakes Power Club—Spring meeting, Palmer House, Chicago, Ill., May 24. Almer Skretting, secretary-treasurer, Wisconsin Eelctric Power Co., Milwaukee 1, Wis.

National Fire Protection Association—Annual meeting, Hotel Statler, Boston, Mass., week of June 3. R. S. Moulton, technical secretary, 60 Batterymarch St., Boston 10, Mass.

American Society of Agricultural Engineers—Annual meeting, New Jefferson Hotel, St. Louis, Mo., June 24-26. Raymond Olney, secretary, St. Joseph, Mich.

American Society for Testing Materials—Annual meeting, Buffalo, N. Y., June 24-28. R. E. Hess, assistant secretary, 260 S. Broad St., Philadelphia 2, Pa.

Canadian Electrical Association—Annual meeting, Banff Springs Hotel, Banff, Alberta, Canada, June 26-28. B. C. Fairchild, managing director, 704 Tramways Bldg., Montreal 1, Que., Canada.

Energy Sales Drop 9.8% in December

Sales of electric energy to ultimate customers in December, 1945, totaled 15,283,489,000 kw.-hr., compared with 16,943,975,000 kw.-hr. in December, 1944, a decrease of 9.8 percent, according to the report issued by the Edison Electric Institute.

Classification of Sales, December, 1945 and Change from 1944

Kilowatt-hour sales December	Million Kw.-Hr. 1945	1944	% Change
Residential or domestic	3,275	2,896	+13.1
Rural (Distinct rural rates)	264	224	+17.8
Commercial or industrial			
Small light & power	2,663	2,642	+0.8
Large light & power	7,561	9,481	—20.2
Street & highway lighting	223	220	+1.4
Other public authorities	540	696	—22.4
Railways & railroads			
Street & interurban	460	459	+0.3
Electrified steam railroads	242	249	—3.0
Interdepartmental	56	78	—28.5
Total to Ult. customers	15,283	16,944	—9.8

Revenue from ultimate customers amounted to $284,844,600 in December, compared with $279,632,900 in December, 1944, an increase of 1.9 percent.

For the twelve months ended December, 1944, the annual use per customer advanced to 1,229 kw.-hr. from 1,151 for the preceding year, an increase of 6.8 percent; the average annual bill to $41.91 from $40.40, an increase of 3.7 percent; revenue per kilowatt-hour dropped from 3.51 cents to 3.41 cents, a decrease of 2.8 percent.

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Florida Power & Light Co. Sells Consumers Water Co.

Florida Power & Light Co. has sold the Consumers Water Co., Coral Gables, Fla., to the Florida Utilities Corp., Orlando, Fla., and the General Waterworks Corp., Philadelphia. The sale price was announced as $927,400.

Ed Keating, who was employed in the rate and research department of Florida Power & Light Co., has resigned to head the water company.

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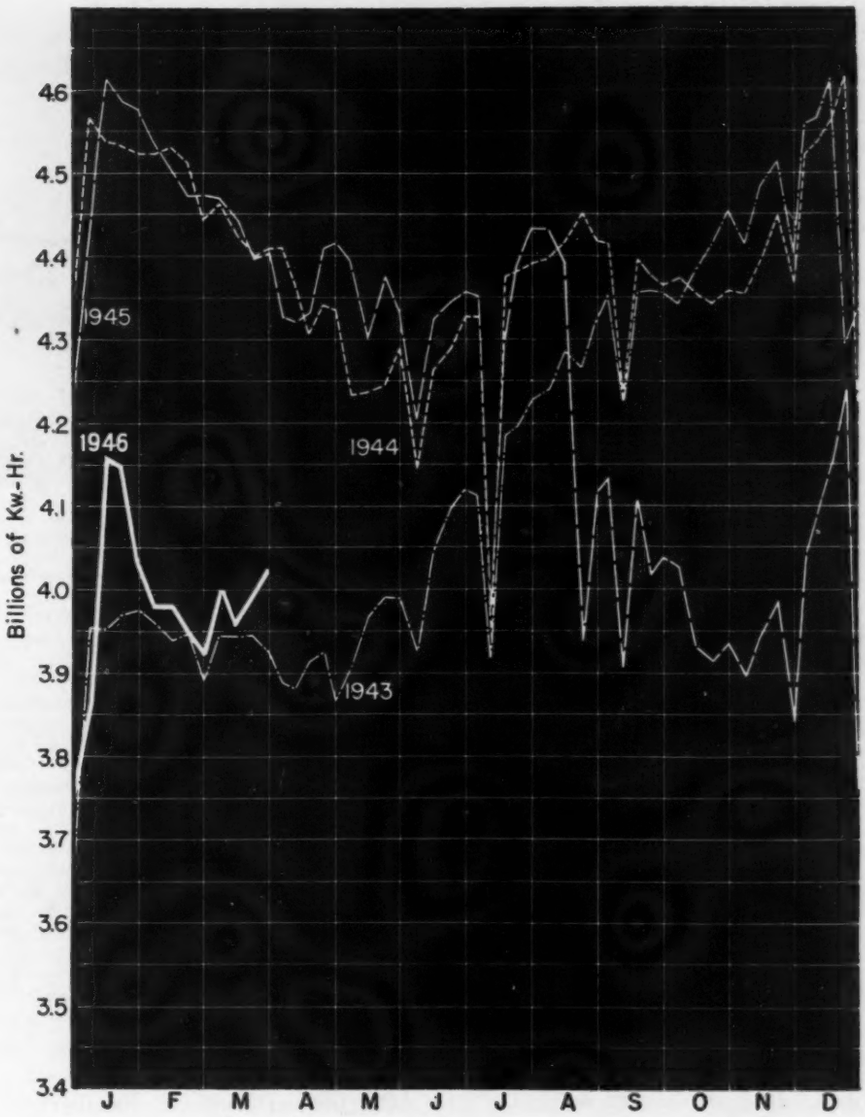
Franchises Renewed

Otter Tail Power Co. has secured renewed franchises and street lighting contracts in Bejou, Calloway, Fertile, and Winger, Minn., and in Page, N. D. New street lighting contracts have been secured at Nashua, Richville, Tintah, and Wendell, Minn., and in Amenia, Ayr, Buffalo, Casselton, and Davenport, N.D.



Output Curve Again Moves Upward

The electric output curve continued to move upward during the week ended March 23, 1946, according to figures released by the Edison Electric Institute. The amount of electrical energy distributed by the light and power industry totaled 4,017,310,000 kw.-hr., compared with 3,987,877,000 kw.-hr. during the preceding week. During the week ended March 24, 1945, the amount of electrical energy distributed amounted to 4,401,716,000 kw.-hr., this year's figure representing a decrease of 8.7 percent. The decrease for the preceding week was 9.3 percent.

Two of the seven major geographical regions of the country reported increases for the week ended March 23 as compared with the corresponding week of 1945—The West Central states with a gain of 0.7 percent and the Rocky Mountain states with a gain of 4.0 percent. The largest decrease was shown by the Central Industrial group with a drop of 13.6 percent. The Pacific Coast states reported the second biggest decrease—10.8 percent.

Weekly Output, Millions Kw.-Hr.

1946		1945		1944	
Mar. 23	4,017	Mar. 24	4,402	Mar. 25	4,409
Mar. 16	3,988	Mar. 17	4,398	Mar. 18	4,400
Mar. 9	3,953	Mar. 10	4,446	Mar. 11	4,426
Mar. 2	4,000	Mar. 3	4,472	Mar. 4	4,465
Feb. 23	3,923	Feb. 24	4,474	Feb. 26	4,445
Feb. 16	3,949	Feb. 17	4,472	Feb. 19	4,512
Feb. 9	3,983	Feb. 10	4,505	Feb. 12	4,533
Feb. 2	3,983	Feb. 3	4,539	Feb. 5	4,524
Jan. 26	4,034	Jan. 27	4,577	Jan. 29	4,524
Jan. 19	4,145	Jan. 20	4,588	Jan. 22	4,532
Jan. 12	4,163	Jan. 13	4,614	Jan. 15	4,539
Jan. 5	3,865	Jan. 6	4,427	Jan. 8	4,568

Percent Change from Previous Year

	Week Ending		
	March 23	March 16	March 9
New England	— 6.1	— 4.2	— 5.1
Mid Atlantic	— 3.6	— 3.0	— 5.7
Central Industrial	— 13.6	— 13.5	— 15.7
West Central	+ 0.7	— 1.2	— 2.4
Southern States	— 8.9	— 9.9	— 11.9
Rocky Mountain	+ 4.0	+ 1.2	— 1.6
Pacific Coast	— 10.8	— 13.4	— 13.4
Total United States	— 8.7	— 9.3	— 11.1

SEC RULINGS

The Securities and Exchange Commission recently issued a series of orders affecting electric utility companies.

CITIES SERVICE POWER & LIGHT CO. has been authorized by the commission to conclude an agreement with certain banks holding its bank loan notes. The agreement provides that the bank loan notes maturing on March 15, 1946, and September 15, 1946, in the principal amount of $1,000,000 on each of these dates be extended to March 15, 1947. It also provides that the proceeds from the disposal of certain collateral will not be required to be applied to the payment of such notes. (Release No. 6483).

STANDARD GAS & ELECTRIC CO.'s request for a further extension of 30 days, within which to call its outstanding $58,601,000 six percent notes and debentures has been granted. This is the third extension granted by the commission, following the original 30-day period given by Judge Paul Leahy in his order of December 29, 1945, for the company to call and pay off its notes and debentures in cash. (Release No. 6498).

ALABAMA POWER CO.'s proposal to issue not more than 300,000 shares of 4.20 percent preferred stock, par $100, redeemable at $105 a share has been approved. The new preferred stock will be offered in exchange to holders of outstanding 159,575 shares of $7 preferred, 170,456 shares of $6 preferred, and 25,845 shares of $5 preferred stocks, plus cash dividend adjustments. At request of the company the commission exempted the issue from competitive bidding requirements. The commission also approved the company's proposal to borrow $7,600,000 from banks on 1¾ promissory notes, proceeds to be used to reimburse treasury for prepayment of 2⅞ percent installment notes and for redemption of unexchanged shares of outstanding preferred stock. (Release No. 6472).

BUFFALO NIAGARA ELECTRIC CORP. has been released from SEC jurisdiction over legal fees and expenses incurred in connection with the issuance and sale of $56,929,000 principal amount of first mortgage bonds, and of 350,000 shares of preferred stock having a $100 par value. (Release No. 6494 and 6495).

COMMONWEALTH & SOUTHERN CORP.'s application for approval of the payment on April 11, 1946, of a dividend of $1.75 per share on each share of preferred stock held as of March 28, 1946, has been approved. A distribution of $1.50 per share was made on January 2 last, while in each quarter during 1945 a dividend of $1.25 a share was paid. After payment of the dividend just approved arrearages on the $6 preferred stock will amount to $29 per share. (Release No. 6476).

CRESCENT PUBLIC SERVICE CO. and its subsidiary, Central Ohio Light & Power Co., having filed a joint application, have received commission authorization for the payment by Central Ohio of a dividend out of earned surplus of $1.68 per share, or an aggregate amount of $33,600, to the sole holder of its common stock, Crescent Public Service Co. (Release No. 6481).

DELAWARE POWER & LIGHT CO. and its electric utility subsidiary, the Eastern Shore Public Service Co. of Maryland, have received commission authorization for Eastern Shore's issuance and sale, from time to time, but not later than August 31, 1947, of not exceeding $1,500,000 principal amount of its 3½ percent promissory notes due October 1, 1973, and not exceeding 15,000 shares of its common stock of a par value of $100 per share, and the purchase by Delaware from time to time of said promissory notes and common stock of an aggregate par value equal to the principal amount of such notes. The proceeds of the sale of these notes and common stock will be used to reimburse Eastern Shore's treasury for money previously expended for construction requirements and to provide funds for estimated construction expenditures during the year 1946. (Release No. 6475).

PUNCHING IN—General Electric Co. employees at Schenectady seem happy to return to work following their strike which was ended by an 18½ cents an hour raise

Municipal System Beaten

A proposed $75.000 bond issue to purchase the distribution system of the Oklahoma Power & Water Co. in Skiatook, Okla., was defeated recently by a close vote.

UTILITY REPORTS

	Net Income 1946	1945
*American Gas & Electric and subs x	$13,016,131	$12,242,884
†Carolina Power & Light	2,613,237	2,361,427
*Iowa Public Service	698,830	656,740
*Southwestern Public Service	1,478,860	1,709,478
*Texas Electric Service	2,753,097	1,749,753
†Texas Power & Light	3,279,953	2,758,406
	1945	1944
‡California Electric Power and subs x	1,379,398	1,278,873
‡Cleveland Elec. Illuminating and subs	5,682,122	5,901,886
‡Delaware Power & Light and subs	1,548,300	1,529,394
‡Florida Power and sub	1,651,169	1,615,220
‡Indianapolis Power & Light	2,121,344	2,082,615
‡Oklahoma Gas & Electric x	2,377,487	2,440,020
‡Rochester Gas & Electric	3,523,441	3,776,472
‡Southern California Edison	10,249,163	10,139,513

*Twelve months ended January 31.
†Twelve months ended February 28.
‡Twelve months ended December 31.
x Preliminary.

Lower Colorado Authority Adds Employee Benefits

Lower Colorado River Authority has announced itself as the first public power agency to establish retirement, life and health insurance plans for its employees not covered by federal social security. The Texas Supreme Court recently ruled the authority may establish such programs.

The retirement plan, retroactive for all employees, is effective upon all employees after five years. The authority's contribution will range from 60 to 90 percent of the total, depending upon each employee's wage.

The authority likewise will contribute toward the group insurance of life, hospital and surgical benefits. Six months employment is the minimum for those covered by these forms.

FPC to Study Licensing of River Hydro Projects

The Federal Power Commission expects to examine hydroelectric projects on twelve rivers during the present fiscal year and that beginning July 1, Chairman Leland Olds told the House Appropriations Committee during hearings on the 1947 Appropriation Bill.

Inquiry will be made with respect to liability of such projects for licensing under the Federal Power Act. Those rivers proposed for investigation during the present fiscal year include the Wisconsin, the Upper Mississippi above the Twin City Dam No. 1, the Illinois, and the Missouri and its tributaries.

Proposed for study in the 1947 fiscal year are the Rappahannock, Roanoke, Yadkin-PeeDee, Seneca, Tallapoosa, Menominee, Willow and Spokane Rivers.

HOW

DESIGN · CONSTRUCT · OPERATE · MAINTAIN

Wedge-Type Collectors Used at Conners Creek

H. E. MACOMBER

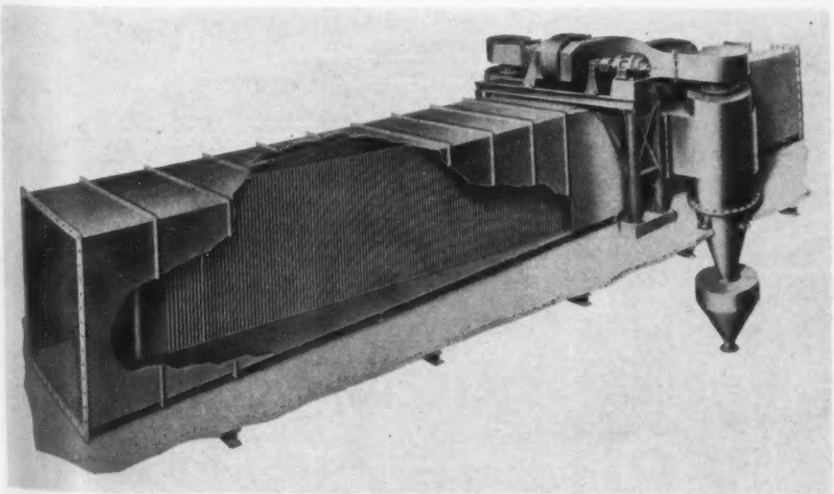
Engineer In Production Dept.
The Detroit Edison Co., Detroit, Mich.

Studies undertaken by the Detroit Edison Co. several years ago to determine what type of dust collecting equipment might be successfully adopted for use with the existing large-capacity, stoker-fired steam generators at its Conners Creek plant have resulted in seven of the eleven boilers being equipped with wedge-type collectors. Latest collector planned for installation was in late 1945, making a total of three for the year. The remaining three units needed to complete this equipment for all steam generators are scheduled for 1946.

Investigation disclosed that where stokers are used to burn coal at rates around 60-70 lb. per sq.ft. per hr., there is a considerable carry-over of solids as fly ash and combustible in the flue gas. In fact, because of the greater content of combustible found in stoker fly ash, the quantity at the higher loads may equal that expected from a pulverized coal installation of comparable output. At fractional loads, however, the quantity of fly ash discharged from a stoker-fired unit drops off much more rapidly than the discharge from a pulverized coal unit.

Because typical stoker fly ash contains a greater proportion of larger-sized particles than pulverized coal fly ash and thus is easier to catch, it was decided at Conners Creek to consider only mechanical collectors, those which depend on sudden changes in direction of flow to throw dust particles out of the gas stream.

In selecting a suitable mechanical-type collector for the Conners Creek plant, principal consideration was given to dimension of apparatus, weight, cost, expected efficiency of collection and, last but not least by any means, the extra friction or draft loss that would be introduced into the flue gas circuit by use of the collector. Considerable importance was attached to this last factor because additional draft loss would tend to restrict the gas handling capacity of the induced draft fan and thus the load which might be carried on the steam generator.



DUST COLLECTOR of the wedge type installed at Detroit plant. Gas-borne dust enters collector inlet (left) and impinges on vanes of wedge. Dust particles deflected by vanes tend to stay outside the wedge and are drawn toward the rear where they are discharged into a cyclone that separates out the dust. Collector shown is made by Buell Engineering Co., Inc.; installed at inlet of I.D. fan or between fan and stack

Operating Principle

Among the collectors considered was a wedge-type collector shown in principle herewith. At the time of the studies no collector of this type had been put in service in this country although some were in use in Holland.

In operation gas-borne dust enters the inlet of the collector and impinges on the vanes of the wedge structure. Dust particles tend to be deflected so as to remain on the inlet side of the wedge while most of the gas passes through, between the vanes, and on to the stack. Dust remaining on the inlet side of the wedge is carried to the rear of the converging wedge chamber and together with a portion of the gas, perhaps 20 percent, is passed through a high-efficiency cyclone which separates out the dust. The gas is propelled through the cyclone by a small auxiliary fan and discharged back into the main outlet duct of the collector.

Wedge collectors worked well in the Conners Creek arrangement. The first unit was dimensioned to replace the duct leading from the I.D. fan to the stack. Thus, the only additional space required was for the two cyclones and fans. Weight was moderate and the cost was the least of any of the collectors considered. Further, the additional draft needed at rated capacity

was about $\frac{3}{4}$ in. of water as compared to $1\frac{3}{4}$ to $2\frac{1}{4}$ in. for other designs.

Of the five Conners Creek boilers that have already been equipped to date, the last four were designed for location on the inlet side of the I.D. fan in an attempt to reduce abrasive wear of the fan blades and possibly, also, obtain improved efficiency. This design was subject to closer structural limitations in spacing and dimensions and restricted access to the top of the air heaters for maintenance and inspection. The decision has now been made to install further collectors between the I.D. fan and the stack in the manner of the first unit, mentioned above.

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A Way to Eliminate Main Field Rheostats

P. H. ADAMS,
Consulting Electrical Engineer
Electrical Engineering Dept., Public Service Electric and Gas Co., Newark, N. J.

Many of the older synchronous generators, motors, and condensers use self-excited exciters and consequently require main field rheostats to insure stability of excitation at all loads. These rheostats in the main field circuit are a source of considerable losses and also produce much heat. It is very desirable to eliminate both of these objectionable features provided the cost is not prohibitive.

During the recent war emergency, the main field rheostats of several synchronous motors on the Public Service Electric and Gas Co.'s system required replacement. A method, shown in the accompanying diagram, Fig. 1, was developed which not only eliminated the need for the rheostats but gave all-around better performance of the excitation system and resulted in a saving of strategic materials, elimination of rheostat losses and undesirable heat in the substations.

The diagram, Fig. 1, which can be used for any synchronous machine under 3,000-kva. capacity, shows the connections and resistances used for a nominal 125-volt exciter and main field where a 60-cell control battery is used to supply exciter stabilization.

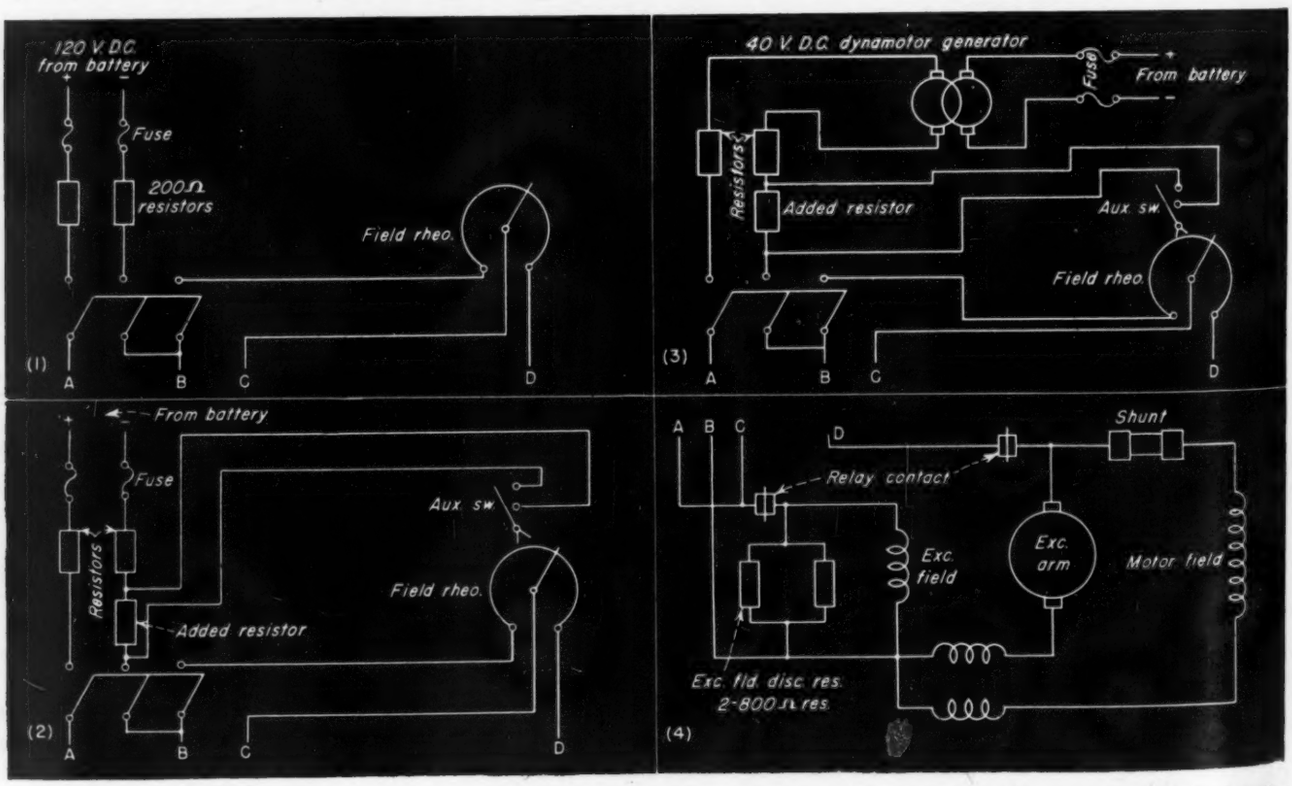
The hand reset tripping relay for the motor main circuit breaker was equipped with two normally closed contacts which were inserted in the exciter field circuit as shown. A field discharge resistor composed of two 800-ohm, 0.5-amp. tubular resistors in parallel was permanently connected across the exciter field terminals to limit the voltage rise when the above circuit breaker was opened. The parallel resistors are used so that loss of one would not remove the arc quenching effect should relay contacts open.

No main field circuit breaker or switch is used. The exciter armature is connected directly to the motor field terminals through a shunt which supplies an ammeter and a relay to protect the exciter against short circuits by energizing the tripping relay mentioned above.

Current Limited

Stabilizing connection from the battery is made through fuses and two 200-ohm, 0.75-amp. resistors and the three-pole, single-throw knife switch. Two 200-ohm resistors limit the battery current to a maximum of about 0.3 amp. and also serve to limit the backfeed to the battery should the exciter voltage exceed that of the battery at any point in its operating range.

The relation between the battery voltage and that of the exciter is such that an exciter of any voltage customarily used for excitation can be stabilized by a battery which can supply a voltage equal to about 20 percent of the exciter rated voltage. Where the voltage of the battery is of



EXCITER field stabilization current supplied by (1) 60-cell control battery, (2) battery having voltage as low as 20 percent of exciter voltage, (3) dynamotor operated from control battery, also (4) exciter connections made through A, B, C and D

this order, Fig. 2 illustrates the method of inserting additional current limiting resistance to protect the battery from excessive backfeed. The values of all the resistances used are, of course, coordinated with the voltages involved.

The auxiliary switch in Fig. 2 is mounted on the rheostat face plate at the point the rheostat arm reaches to equalize exciter and battery voltage. An extension of the rheostat arm is provided which opens or closes this switch as the arm passes this point in the raise or lower movement. Opening the switch inserts the additional resistance in the battery circuit and closing the switch cuts it out. The value of resistance needed is easily calculated.

Synchronous units of more than 3,000 kva. may require a stabilizing current that becomes an excessive drag on the control battery, though 3 to 4 amp. are usually sufficient. Currents such as this are being supplied as shown in Fig. 3, where a small dynamotor is inserted between the battery and the field to keep the battery current at a minimum. The motor of this unit operates at battery voltage while its generator delivers at 40 volts the current required by the stabilizing circuit. This method of supplying the stabilizing current also has the advantage of insulating the battery from the exciter field circuit.

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New D.C. System For Remote Positioning

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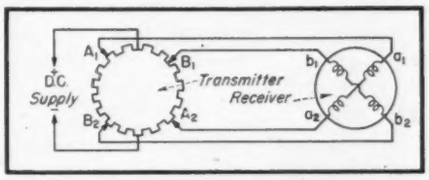
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

A new remote control system that can be operated from either a.c. or d.c. lines and that performs the functions of accurate positioning and indicating has been developed by Allis-Chalmers Mfg. Co. for steam and hydroelectric station, marine and industrial c ntrol needs. Construction of the apparatus is novel although simple. The receiver is the positioning unit. Relative strength of the magnetic fields of its stator determines the position that the 2-pole permanent magnet rotor will assume. Any change in this relationship of the field strength causes the rotor to turn and assume the position corresponding to the new resultant of the two fields. The receiver torque is a function of the displacement between the rotor and the magnetic axis of the receiver. Immediate receiver response without hunting or overshooting is attained over the entire operating range of the system.

A schematic diagram of one type of system is shown herewith. The transmitter—essentially a variable resistance bridge that controls the relative strength of the receiver magnetic field—consists of a wound circular resistor element, made up of four similar quadrants each specially tapered. Direct-current is supplied (directly or by an a.c. rectifier) to two diametrically opposite points through collector rings. The transmitter brush assembly carries the four rolling contacts, each set at 90-deg. intervals around the stator circle. Leads from these four contacts run to the four receiver winding terminals.



D.C. POSITIONING SYSTEM — Accurate remote positioning and indicating functions are performed by the new d.c. system diagramed above. The transmitter, in effect a variable resistance bridge, controls the relative strength of the receiver magnetic fields which in turn determine the position its receiver rotor will assume. Close linearity maintained

In operation, assume the transmitter contacts A_1 and A_2 are directly in line with the d.c. supply center taps. Maximum current will then flow through receiver coils a_1 and a_2 and the rotor will take up a position corresponding to the magnetic axis of the field produced.

When the transmitter rotor is turned through 90 deg., contacts B_1 and B_2 are in line with the supply taps. Receiver coils a_1 and a_2 no longer have current flowing through them, while coils b_1 and b_2 are energized at maximum. The receiver rotor follows through this 90-deg. shift.

At all points between these positions current flows through both sets of coils. Since the transmitter resistance windings are tapered to produce sinusoidal current distribution in the receiver, the rotor angular position is the vectorial resultant of the currents in the two receiver phase windings throughout the entire circle.

The relationship between receiver and transmitter rotors is similar to that existing between an a.c. generator and a synchronous motor. Receiver motor will remain in step at all times within its pull-out torque rating. On overload, rotor simply stops, but load current remains unchanged. When overload is removed, receiver assumes correct position.

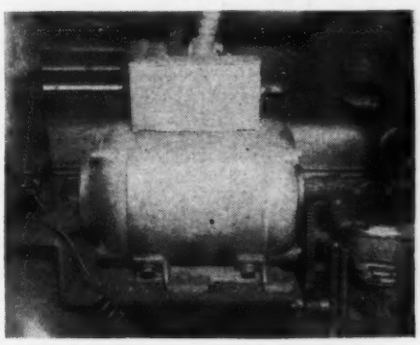
Other unique advantages of the system are: (1) Complete elimination of "hunting;" (2) absence of any receiver torque reaction on transmitter; (3) advantage of torque amplification (several hundred to one possible) and (4) close limitation of circuit power requirements.

Inductive circuit reactance is also eliminated, and close linearity can be maintained throughout the 360 deg. After an intermittent power failure the receiver instantly swings into step.

Applications

Since one transmitter can serve a number of receivers either for control or indication, an endless variety of applications is possible. Distance between units is limited only by the d.c. voltage drop in the four connecting lines. Central stations, traction and marine propulsion systems, valve controls, temperature or pressure indicating, reversing motor controls, and steering gear controls are but a few of the many easily adapted applications.

Cost of the system is comparable to existing types and current consumption is low. Since the larger size systems require only several hundred watts at 125 volts d.c., operation from an a.c. line using a small rectifier unit is economical and practical.



POSITIONER APPLICATION — D.c. positioner is shown, above, installed as governor control on a diesel electric switch engine. The transmitter is mounted integral with the drum controller in the cab

Method for Extending Range of Q-Meter

G. F. BARNETT*,
Research Physicist
Johns-Manville Research Laboratory
Manville, N. J.

Volume resistivity, dielectric constant and power factor of electrical insulators having poor high frequency electrical qualities can be measured by an extension of the range of the Q-meter. The method as outlined here is suitable throughout the range of frequencies from 500 to 5,000 kilocycles. The insulating materials are inserted as the dielectric between the plates of a test condenser.

If a small condenser X_a is placed in series with the test condenser containing the material under test as a dielectric, the Q of the combination by proper adjustment of the value of X_a is increased to the point where accurate measurements may be made when the combination is connected in parallel with the Q circuit. The parallel resistance R_p and parallel reactance X_p of the combination are calculated by the standard method of measurement of any impedance described in the Q-meter instruction book, which assumes that the impedance Z_1 presented to the Q-meter is made up of elements as shown in Fig. A.

The actual impedance Z_2 presented to the Q-meter is made up of the capacitive reactance X_a in series with the parallel combination of the true resistance R of the material under test and the true capacitive reactance X of the test condenser with the material under test as a dielectric. This actual impedance is shown in Fig. B.

Impedances Z_1 and Z_2 are equal. Using terminology of the Q-meter instruction book, effective resistance R_s and reactance X_s are known values measured by a parallel connection in the Q circuit. Also X_a is a known value. Then the true resistance R and reactance X can be determined by the formulas:

$$R = [R^2_s + (X_s - X_a)^2]/R_s$$

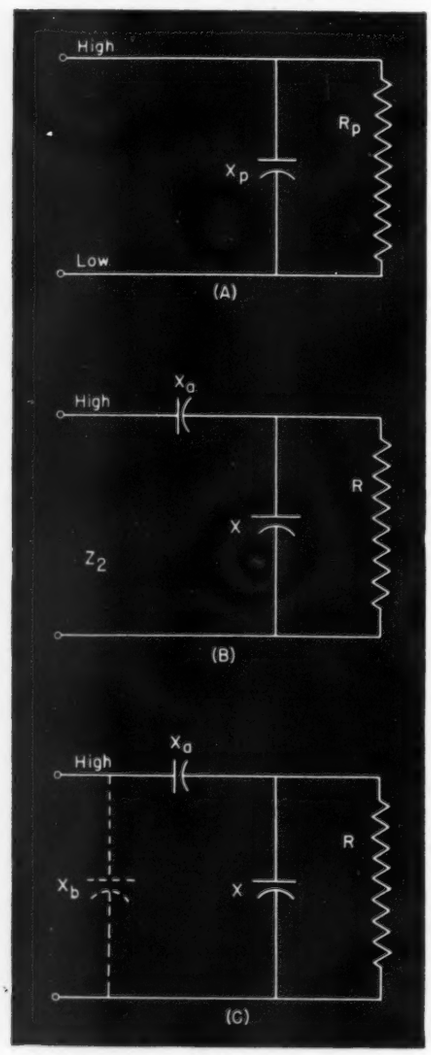
$$X = R^2_s + (X_s - X_a)^2]/(X_s - X_a)$$

Having obtained the values of R and X, calculation of volume resistivity, dielectric constant, power factor and other quantities follow in the usual manner.

If the condenser X_a is made too large in capacitance, the Q of the circuit will not be increased sufficiently to allow accurate results; if it is made too small, the lead capacitance X_b will become appreciable and the combination of elements will be similar to that of Fig. C. and result will be in error when the above equations are used. To minimize the error due to lead capacitance the high lead should be disconnected at the terminal of the impedance combination to obtain open circuit resonance, rather than at the terminal of the Q-meter.

In the actual setup used, a radio receiver trimmer condenser was used as the capacitive reactance X_a. Its capacity range was approximately 10 to 60 micro-microfarads. Its terminal was connected directly, with the shortest possible lead, to the test condenser. It was oriented in such a way that its plate, which was connected to the test condenser, gave maximum shielding between its other plate and the test condenser. Connected directly to the high terminal of X_a was a small metallic cup filled with mercury into which the high lead from the Q-meter could be dipped to make and break contact. By breaking the contact at the high terminal of X_a, the error introduced by the lead capacitance of the lead from the Q-meter to the test setup was held to a minimum.

* Now Research Physicist, Philco Radio and Television Corp., Research Division, Philadelphia, Pa.



IMPEDANCE presented to Q-meter with trimmer condenser as range extender

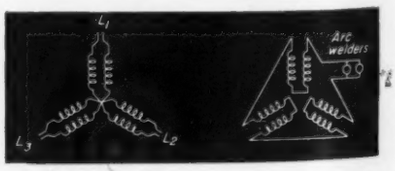
Arc Welding Machines Aid Varnish Baking

The process of baking insulating varnish on a turbo-generator stator was facilitated by electric arc welding machines in conjunction with infrared lamps. These equipments were used as a result of some "on the spot" thinking by the electrical superintendent of Southwestern Cement Co., Osborn, O.

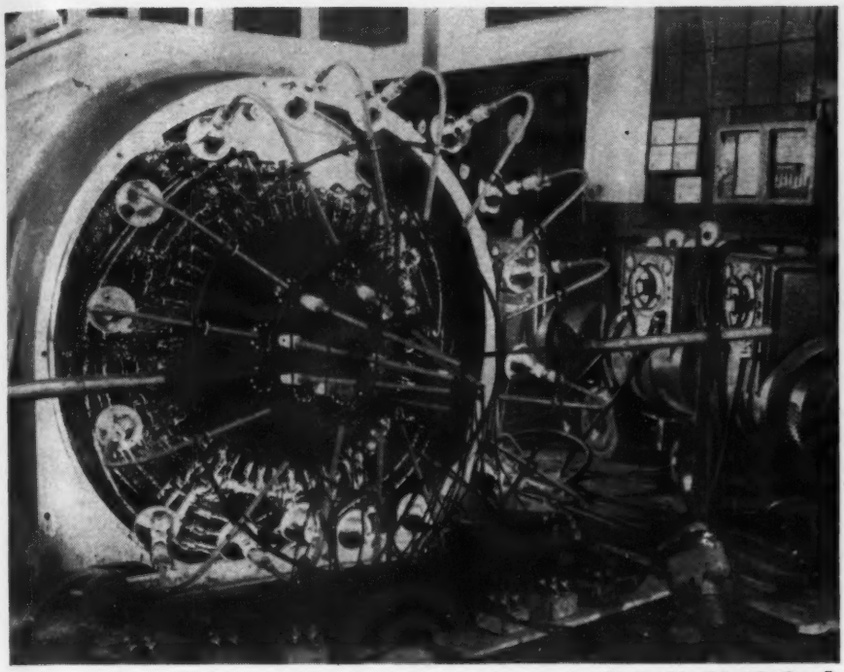
Scheduled maintenance called for the removal of the generator rotor and thorough cleaning by washing the stator winding, and after drying it was decided to apply a heavy sealing and protective film of long-life, flexible insulating varnish.

Oven baking was not practicable and equipment available for baking was infrared lamps and three Hobart 400-amp. electric arc welding machines. It was finally decided to heat the winding internally with direct current from the arc welding machines connected in parallel series and to heat externally with a framework of twenty-four 375-watt infrared lamps focused in each end of the windings.

The generator winding was connected two-parallel star and rated 940 amp. per terminal or 470 amp. per path. It is desirable to pass current through the entire winding at one time, and since each path of the star-connected generator had a relatively low resistance it was evident that as much of the winding as possible should be connected in se-



GENERATOR STATOR windings (left) connected parallel star, (right) connected in series and to two paralleled arc welding machines to aid varnish baking



Courtesy The Hobart Brothers Co.

ARRANGEMENT of infrared lamps used at each end of generator, which, together with arc welding machines (at right), maintained a temperature of 250 deg. F. for 12-hr. baking cycle. Twenty-four 375-watt lamps were mounted on each frame

ries. This was accomplished by opening the star points on the generator winding and connecting all paths in series as shown in the accompanying sketch. With this scheme only two arc welders are used.

The voltage was set at a low value and slowly increased, allowing ample time for the heat in the copper to be conducted to the outer surfaces of the coils where it could be measured by a thermometer. The current drawn through the generator winding was finally set at 15 volts and 420 amp.; and with the two banks of infrared lamps at each end of the windings, a stable temperature of 250 deg. F. was reached and maintained for the required baking time of twelve hours per varnish treatment. A total of three varnish coatings was applied to the generator winding by flooding with an air syphon gun, each treatment being followed by a 12-hr. bake.

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Transformer Loading Checked Continuously

Verification of distribution transformer loading is done on a progressive and continuous basis on the overhead system of the Kansas City Power & Light Co. the year round. Proceeding systematically through the system, load checks are made at the rate of 700 to 900 per year. About 13 percent of the 5,838 transformer stations on the 2,300/4,160 volt system are investigated every twelve months, with the result that the entire system is covered once in seven years.

All load verifications are made on the primary of the transformer, using either graphic ammeters in conjunction with split-core or weather-proof current transformers or Lincoln ½-hr. maximum thermal-type ampere demand meters. These instruments, properly housed, are installed at each transformer station for a full week. Very few spot or short-time transformer load checks are used on this system.

Of the stock of instruments employed for these tests, about ⅓ are the recording type; ⅔ the indicating thermal type.

Instruments are placed and removed by a two-man crew operating from a car or light truck two days each week. They make about 18 or 20 installations each week.

Load Records

Two types of records are kept. For transformer stations up to 37½-kva. capacity, the connected load of individual customers served by a given station is recorded, as well as the transformer test readings. On transformers larger than 37½ kva., however, no attempt is made to keep track of customer connected load and only the load tests are recorded. This is because the changes in connected customer load are too rapid, on the larger transformer, for records to have significance. Data is recorded on 5 by 8¾ in. cards (shown) for each transformer station, by location. The card carries the number, size, date of connection and order number of the existing transformer installed at this station.

1944 Transformer Testing Data—Missouri District

	1941	1942	1943	1944
No. Demand & Graphic Tests	705	649	747	909
No. Stations changed (Overload)	88	63	62	60
Capacity found on stations changed	1,955	1,615	1,420	1,625
Capacity left on stations changed	3,310	2,600	2,180	2,545
Capacity increase on stations changed	1,355	985	760	920
Percent changed	12.5%	9.7%	8.3%	6.6%
Tests in percent of 2,300 volt stations	12.4%	11.4%	13.0%	15.6%
Loading (as found) on changes only	148.0%	149.3%	142.0%	146.4%
Loading (as left) on changes only	87.4%	92.7%	92.5%	93.5%
Average Loading (as found)	93.9%	91.2%	87.6%	89.3%
Average Loading (as left)	88.1%	87.0%	85.2%	86.6%

STA. NO. 44

K. C. P. & L. CO. TRANSFORMER LOAD RECORD

CLASS	WIRE	VOLTAGE	PHASE
PRIM.	3	2,300	1
SEC.	3	115/230	1

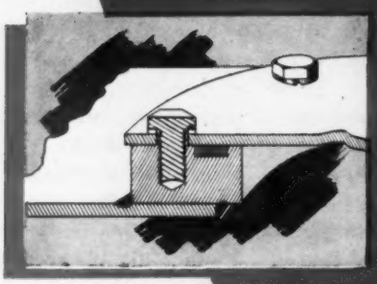
NUMBERS	KVA	CONN.	DIS-CONN.	ORDER NO.	NUMBERS	KVA	CONN.	DIS-CONN.	ORDER NO.
C-11057	10	7/28/41		T-2097					

DATE	CUSTOMER'S ADDRESS	CLASS SERVICE Map No. 48	TYPE LOAD	* CONNECTED LOAD KW.					** TESTED LOAD			REMARKS
					KW.	R	L	TOTAL	R	L	TOTAL	
	5410 Main		Res.	1.0				1.0		3(W)		
	12			.7				1.7				
	25			.8				8.9		3(W)		
	27			.8				9.7				

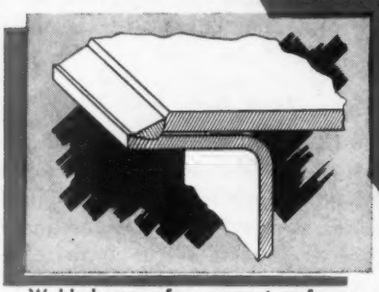
STA. NO. 44 LOCATION Rear 5410 Main SECONDARY DISTRICT

TYPICAL transformer station record for 10-kva. installation serving 29.4 kw. of connected load. Reverse side is used to continue the connected and tested load data

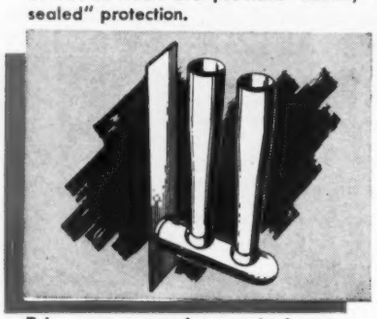
Maintenance Savings Begin with Design of the *tank* of a G-E TRANSFORMER



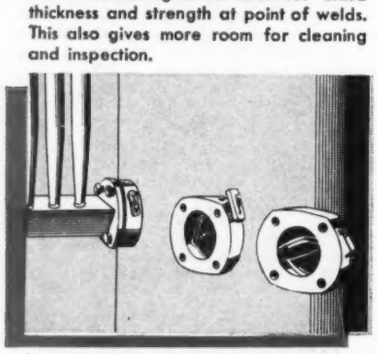
Synthetic rubber gasket, plus metal-to-metal bolting gives weatherproof, liquid-tight joint on transformers rated above 2000 kva.



Welded cover for power transformers of 501 to 2000 kva provides "factory-sealed" protection.



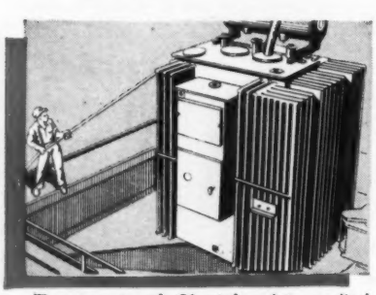
Tubes are swaged at ends for extra thickness and strength at point of welds. This also gives more room for cleaning and inspection.



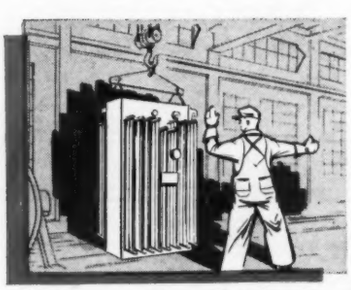
Larger tanks have detachable radiators. Radiator valves permit removal without draining the tank.

In a G-E power transformer tank there is no such thing as a "minor detail." From the laboratory controlled selection of open-hearth steel plate, down to the 3 baked-on coatings of Glyptal paint, these tanks are built to give utmost protection to core and coils—*with a minimum of inspection and maintenance.*

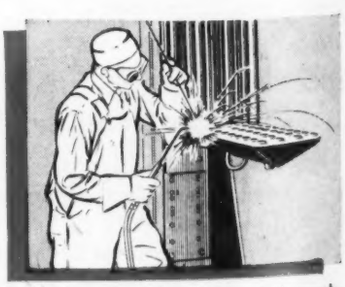
Efficient protection of the insulating liquid from leakage, moisture absorption and oxidation is essential to trouble-free service. In the manufacture and design of G-E tanks, no effort is spared to provide oil tightness and moisture-proof construction. At the same time, all precautions are taken to assure that the unit will retain these maintenance-reducing qualities through many years of service under all weather conditions. Advanced welding methods, pressure-



Three coats of Glyptal paint, applied on a clean, smooth, shot-blasted surface offer maximum resistance to weather.



Cover can be taken off and core and coils removed without completely draining tank.



Radiators are fabricated and thoroughly tested prior to their installation on the transformer tank.

These G-E tank-construction features keep maintenance costs low

1. Conveniently located filter press connections and oil sampling valve enable easy testing and conditioning of oil.
2. Welds which hold liquid are made externally for accessibility.
3. Tubes are braced against vibration.
4. Glyptal paint, applied over clean, shot-blasted surface inhibits corrosion.
5. Tubes are sturdy, swaged at ends to increase thickness at point of welding, and to reduce strains.
6. Tank is open-hearth steel, checked for carbon content to insure good welding qualities.
7. Properly compressed synthetic rubber gaskets or non-porous welds seal all tank joints.
8. Tube and header construction contributes to oil tightness by radically reducing the number of openings in the tank wall.

The tank is an integral part of a G-E transformer. Strength, shape of housing, liquid tightness, resistance to weather have all been considered. The result is a tank that is **durable**; that requires only a **minimum** of maintenance throughout the life of the transformer.

ing of welds, the use of synthetic rubber gaskets, uniform -painting—all are major factors in the construction of tanks.

his detailed forethought in the design of the tank typifies design of every element of a G-E transformer. First-hand erience with field maintenance conditions, an outstanding wledge of electrical design, and testing with the most up-date facilities have anticipated every feature that will cut vice costs and keep your transformer in continuous, efficient ration.

f you are in the process of selecting a transformer, look these features that will result in tangible savings in instal-on and maintenance costs. For information call your nearest representative, or write to *Apparatus Dept., General tric Company, Schenectady 5, N. Y.*

POWER TRANSFORMERS

GENERAL ELECTRIC

401-32-5155

Series Capacitor Overcomes Bad Voltage Fluctuation

C. F. MYERS*
Puget Sound Power & Light Co., Seattle, Wash.

By means of series capacitors, a serious distribution voltage fluctuation has been overcome by Puget Sound Power & Light Co. at Skykomish, Wash. The town of Skykomish is served through a small 12,500/2,400-volt step-down transformer bank which, in turn, is supplied by means of a 3.3-mile, 12.5-kv. line of No. 4 copper conductors. This line is energized through a 1,200-kva., 2,400/12,500-volt step-up bank at the company's Grotto substation by means of a 3,000-kva., 110,000/2,400-volt step-down transformer bank serving, in addition, a cement mill at Grotto.

The 12.5-kv. line also serves a lumber mill near Skykomish through a 750-kva., 12,500/480-volt step-down transformer bank. This mill increased its connected motor load from 645 to 1,500 hp., which included a 300-hp. motor operating a head saw, and an extremely variable load on this motor largely contributed to troublesome fluctuating voltage at Skykomish.

Most of the voltage drop was in the 1,200-kva. Grotto transformer bank, although there was a substantial drop in the 12.5-kv. line. Increasing the conductivity of the 12.5-kv. conductors, or stringing additional conductors in parallel and increasing the capacity of the step-up transformer bank to decrease its impedance sufficiently at Grotto substation would have solved the problem but would have been comparatively expensive. Moreover, the capacitors released an induction regulator for service elsewhere.

Use of 12.5-kv. series capacitors, manufactured by the General Electric Co., installed as indicated, proved to be an entirely satisfactory and a much less costly solution to the problem. The capacity (five 13-kv., 15-kva. units per phase, approximately 133 kva. total on 12-kv. system) was chosen so that the capacitive reactive rise through the capacitors would equal the impedance drop through the 1,200-kva. step-down transformer bank and the line.

As indicated in Fig. 1, the capacitors were installed at the 12.5-kv. line terminus at Skykomish but ahead of the lumber mill connection. A comparison between A and B of Fig. 2, reproductions of simultaneous graphic recordings of 12.5-kv. line voltage ahead of, and on the load side of, respectively, the capacitors, indicates the effectiveness of the installation in practically eliminating voltage fluctuations and also in improving voltage regulation.

The scheme of protecting the capacitors against high voltages during short circuit conditions is shown diagrammatically in Fig. 1. Each capacitor is shunted by a protective gap which arcs over at a voltage predetermined by the gap spacing. The arc current flows through the closing coil of a contactor which shunts out both the capacitor and the arc gap. This not only protects the capacitor from voltage but allows the system impedance to be effective in reducing short-circuit current. The contactor is held closed by a holding coil in series with the contactor. Upon restoration of normal line current, the contactor opens automatically, thus inserting the series capacitor back in the line.

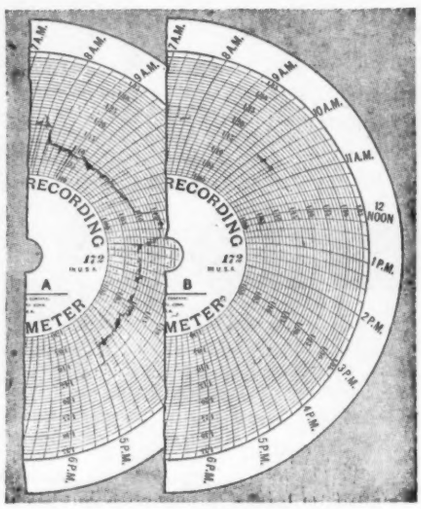


FIG. 2, A—12.5-kv. line voltage ahead of capacitors; B—Simultaneous voltage on load side of capacitors showing greatly improved conditions, even eliminating sudden voltage fluctuations caused by 300-hp. sawmill headsaw motor.

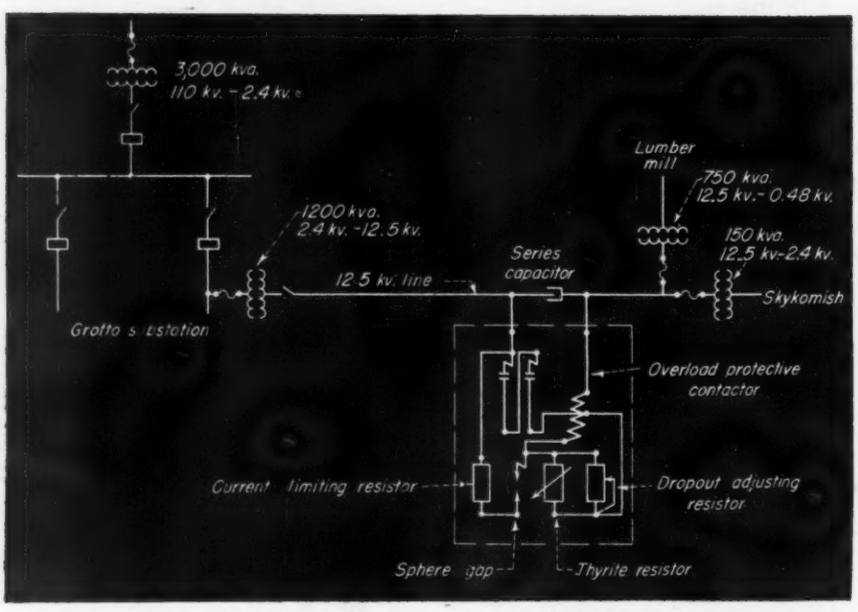


FIG. 1—Single-line diagram of power circuits, series capacitors and protective equipment

* Engineer, transmission and distribution.

Distribution Staff Duties Summarized*

Maintenance Supervisor

Special tasks handled by the maintenance supervisor are presented here. These are in addition to the responsibilities for operation of distribution circuits, maintenance of equipment and operating check-ups as outlined in ELECTRICAL WORLD, March 16, 1946.

The maintenance supervisor is responsible for a semi-annual inspection of all important ground connections including grounds on cable sheath connections at the end of ground or sheath return circuits and substation grounds. These are made on or before May 1 and November 1. He arranges for necessary guards at unattended substations, etc., on special occasions like Halloween night, July 3, etc., and for snow removal from outdoor switch yards and

* One of a series of presentations covering the essential duties of distribution department officials in an electric utility company serving between 50,000 and 75,000 meters. First installment in ELECTRICAL WORLD, October 13, 1945, page 106.

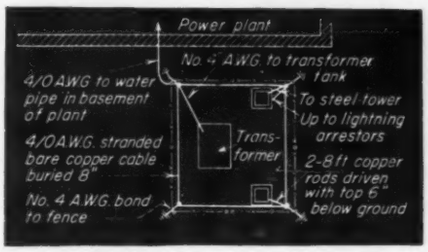
transformer banks, and from improved sidewalks adjoining stated company owned land. Before new substations, transformer vaults of large capacity, capacitor installations and super-manholes are placed in service, the maintenance supervisor inspects them to see if transformers, fuses, etc., are of proper size, rubbish has been removed, proper ventilation provided, locks installed, and everything is in good condition for operation. Immediately after such installations go into service, he conducts every emergency man to the location and instructs each one as to the purpose and operation of the apparatus there located.

He may call upon the electrical construction foreman for assistance and is charged with the assignment of safety supervisors to required jobs. He checks, initials and dates all tagging lists issued to persons within or without the distribution division, and is responsible for an annual safety inspection of transformer banks on the ground. Finally, he keeps an up-to-date list, arranged by circuits, of all customers (demand 100 kw. or over and certain others) whose production and/or special processes would be seriously affected by service interruption. This list is checked on the first working day of each month, corrected, and given to the distribution superintendent for transmission to chief load dispatcher.

•

To Ground An Outdoor Substation

A 1,500-kva., to 2,400- to 22,000-volt transformer substation located a few feet outside a hydroelectric installation will be provided with grounding facilities as illustrated. The inclosure is surrounded by wire fencing. Economical use of material is indicated by making the basic installation a No. 4/0 stranded bare copper cable buried 8 in. below the ground surface, bonding each corner with No. 4 copper to the fence, providing two 8-ft. copper rods at each corner driven with tops 6 in. below the earth, and tying two steel towers carrying the high-voltage bus, lightning arrester ground terminals and the transformer tank into rectangular ground bus. The latter also has a No. 4/0 connection to a water pipe in the basement of the adjacent station.


Power plant
No. 4 A.W.G. to transformer tank
4/0 A.W.G. to water pipe in basement of plant
To steel tower
Up to lightning arrestors
Trans-former
4/0 A.W.G. stranded bare copper cable buried 8"
2-8 ft copper rods driven with top 6" below ground
No. 4 A.W.G. bond to fence

GROUND bus follows fence contour

•

Charts Accident Causes For Field Study

Lost time accidents, hours worked and the number of days lost each month from accidents are compiled into a monthly summary by departments of Texas Power & Light Co. and for the company as a whole. This report, using the illustrated forms, is sent to the field for discussion by the foremen and their men.

At the end of the year the causes and costs of all accidents are compiled and sent to the field employees for discussion at regular safety meetings.

Field safety Engineer T. D. Hughston of the Texas company points out that these reports give management as well as employees the facts as to where and why these accidents are occurring. Supplemented by detailed reports of individual accidents citing primary and contributing causes, these records have a high accident prevention value.

DEPARTMENT ACCIDENT RECORD, Month Ending _____ Year _____

Engineer, Superintendent or Foreman	TOWN	Number employes on payroll this month	Number hours worked this month	Total hours worked to date this year	Number Lost Time Accidents this month	Total number Lost Time Accidents to date this year	Number days lost this month	Total number days lost to date this year	Total Hours Worked Since Last Lost Time Accident	Date on Which Last Lost Time Accident Occurred	Date Made Foreman of this Crew or Department

MONTHLY SUMMARY OF ACCIDENTS

ALL DEPARTMENTS

Month Ending _____

TEXAS POWER & LIGHT COMPANY

(Miscellaneous includes employees in general offices, sales forces, and local district clerical organization)

DEPARTMENT	Number employes on payroll this month	Number hours worked this month	Total hours worked to date this year	Number Lost Time Accidents this month	Total number Lost Time Accidents to date this year	Number days lost this month	Total number days lost to date this year	Total Hours Worked Since Last Lost Time Accident	Date on Which Last Lost Time Accident Occurred

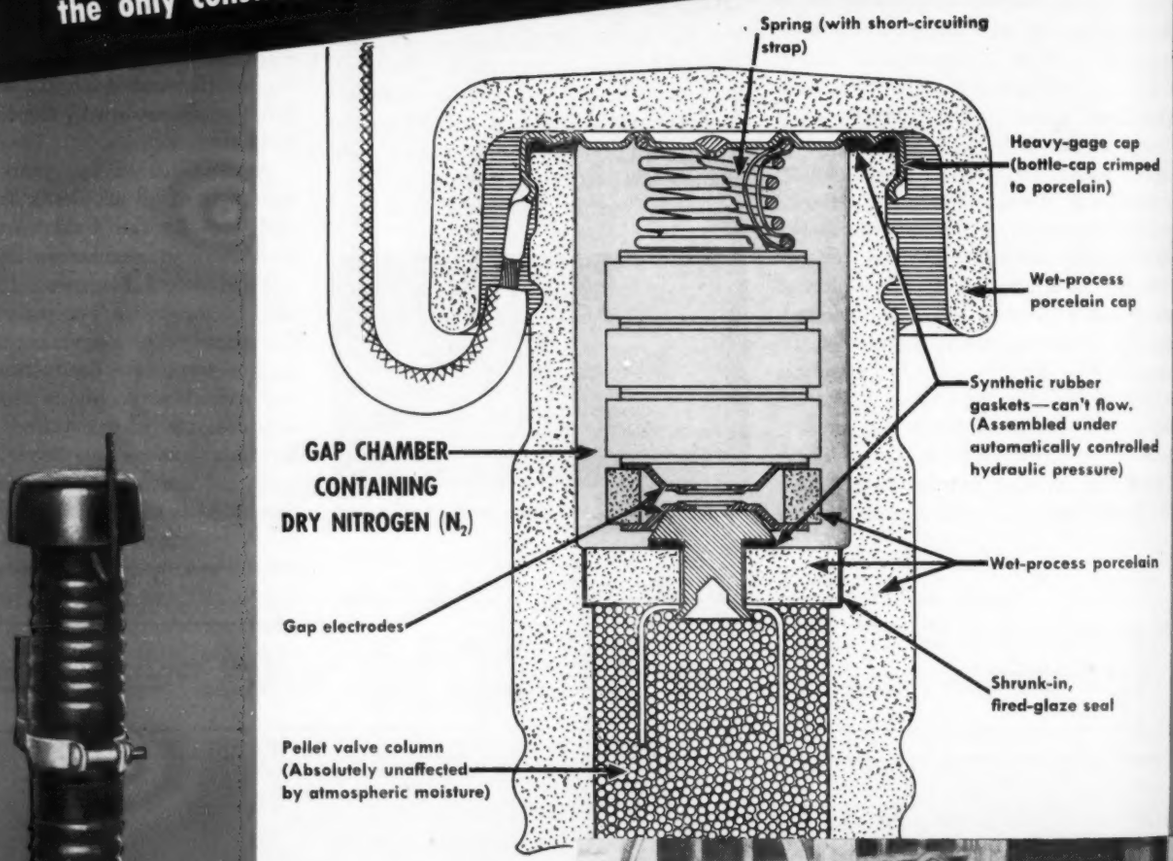
ALL DEPARTMENTS	FREQUENCY RATE	SEVERITY RATE	
Current Month			
Year to Date			
Same Period Last Year To Date			

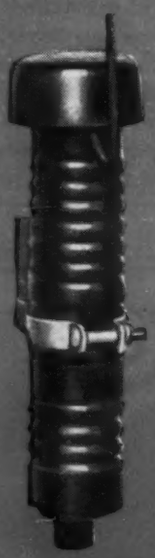
$$\text{Frequency Rate} = \frac{\text{Total Lost-Time Accidents} \times 1{,}000{,}000}{\text{Total Hours Worked}}$$

$$\text{Severity Rate} = \frac{\text{Total Days Lost} \times 1{,}000}{\text{Total Hours Worked}}$$

The G-E pellet arrester with new

The G-E pellet arrester is the only distribution lightning arrester that has a separately sealed gap chamber — the only construction adapted to N_2-treated series gaps

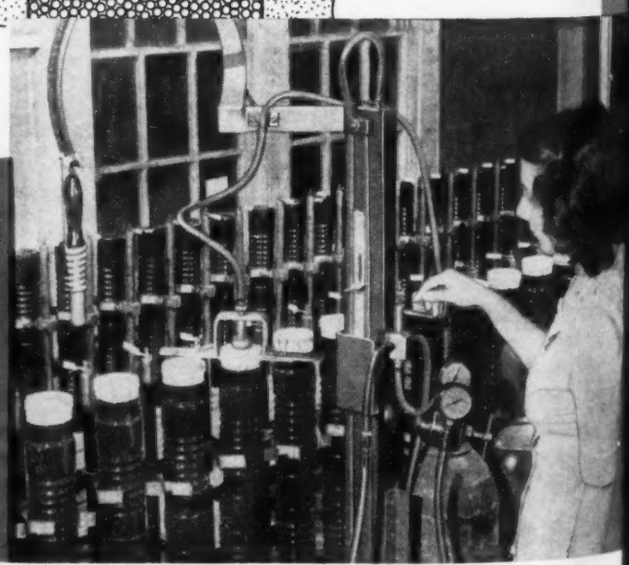

Spring (with short-circuiting strap)
Heavy-gage cap (bottle-cap crimped to porcelain)
Wet-process porcelain cap
Synthetic rubber gaskets—can't flow. (Assembled under automatically controlled hydraulic pressure)
GAP CHAMBER CONTAINING DRY NITROGEN (N_2)
Wet-process porcelain
Gap electrodes
Shrunk-in, fired-glaze seal
Pellet valve column (Absolutely unaffected by atmospheric moisture)



Sectional construction of 9-kv pellet arrester, typical of other ratings, showing separately sealed N_2-filled gap chamber containing series gaps.

PELLET ARRESTERS

A section, of the pellet arrester assembly line, showing the station for evacuating, vacuum testing, injecting nitrogen, and final sealing.



N_2-Filled gap chamber assures A NEW HIGH IN RELIABILITY

The *new* pellet arrester has these exclusive *CONSTRUCTION* features:

1. All air and atmospheric moisture (usually sealed in the arrester with *ordinary* manufacturing methods) are completely evacuated from the gap chamber.

This positively excludes the moisture of normal atmospheric humidity from the series gaps of the arrester, thus eliminating oxygen, the essential agent for ozone and all forms of oxidation, and eliminating the recognized adverse effects of internal condensation ("dewing") caused by changes in outdoor temperature.

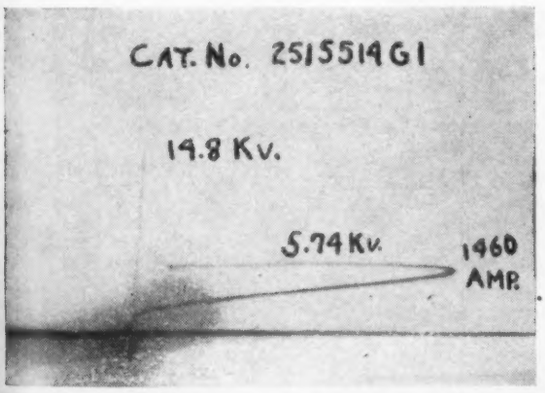
2. A vacuum test assures tightness of gasket seals.

The evacuation of air and moisture provides an error-proof, routine, vacuum-withstand test of the main sealing of each arrester. Thus, any unit having the slightest leak is detected and rejected.

3. Dry nitrogen (N_2) is injected into the gap chamber, and the small "treating" hole in the metal cap is immediately solder-sealed.

The injected dry-nitrogen permanently sealed in the gap chamber is *inert*. It prevents the formation of any ozone or oxides; keeps the gap electrodes bright as new during years of service operation, and gives more stable gap-sparkover characteristics.

The *new* pellet arrester—like its predecessor—is also distinguished by these outstanding *ELECTRICAL* characteristics:



The excellent impulse protective characteristics of pellet arresters *stay excellent.* Here is an oscillogram of a 3-kv pellet arrester *after 18 years of continuous service operation.* The arrester was manufactured in 1924.

1. Low impulse breakdown voltage to start discharge.

2. Exceptionally low IR drop, even at high discharge currents.

3. Large discharge capacity for severe lightning strokes.

4. Valve action; no exposed live parts or arc flame. Pellet arresters can be used on *any* part of *any* distribution system, rural or urban.

Ask for Bulletin GEA-2975 for complete information on G-E pellet arresters. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC

DIMENSIONAL AND OPERATING DATA OF FLUORESCENT LIGHT SOURCES

This comparison of sizes, ratings and operating characteristics of cold cathode, hot cathode and slim line fluorescent light sources was compiled from manufacturers' published data available as of October, 1945. Data is subject to change with developments subsequent to that date.

Compiled by CHARLES N. LAUPP, Commercial Lighting Supervisor, Wisconsin Electric Power Co., Milwaukee, Wis.

ITEM	COLD CATHODE		HOT CATHODE					
			STANDARD LINE		SLIM LINE			
					MEDIUM VOLTAGE Top Line —0.1 amp. Bottom Line* —0.2 amp.			
	LOW VOLTAGE	SERIES OPERATION	PRE-HEAT	INSTANT START				SERIES OPERATION
1. TUBE DIAMETER	1"—20–25 mm.	10, 12, 15, 20, 25 mm.	T12(1½"), T17(2½) & T8(1")	1½"	T6(¾")	T6(¾")	T8(1")	T8(1")	Probably all sizes
2. USUAL LENGTH	7' 9"—(93")	Various lengths. 93" lamps in series up to 90'	4'—(48") 3'—(36") 5'—(60") 1.5'—(18")	4—(48")	42"	64"	72"	96"	Probably all lengths
3. SHAPE	Usually straight Can be bent	Usually curved sections	Straight	Straight	Straight				May be curved
4. COLORS	3500° White Daylight Soft White	Wide variety of colors	3500° White-Red, Pink, Blue, Daylight-Green, Gold, 4500° White, Soft White	3500° White Daylight 4500° White	3500° at present (White)				Should be wide selection in future
5. TUBE BRIGHTNESS Foot-Lamberts	White—1540 ft.-L.	Will vary with size and current	4'—3500° = 1700 ft.-L. Varies with size and color	4'—3500° = 1600 ft.-L. Varies with size and color	1560 2420	1600 2460	1070 1790	1120† 1870†	
6. LUMEN OUTPUT	White 2200 l/7' 9" lamp—284 l/ft.	37 to 517 l/ft. 240–290 for 25 mm. 3500° White	2100 lumens 525 l/ft. 4'—3500° White	2100 lumens 525 l/ft. 4'—3500° White	900 257/ft. 1400* 400/ft.	1400 263/ft. 2150* 402/ft.	1400 233/ft. 2350* 391/ft.	1950 244/ft. 3300* 412/ft.	No available data
7. WATTAGE	Input for 2 lamp = 218 w. 14.1 watts per ft.	1" tube 8–10 w/ft.	100 w. (2-lamp, 40v.) 25 w/ft./2-lamp 12½ w/ft./lamp	107 watts 29 w/ft./2-lamp 14½ w/ft./lamp	15 4.3/ft. 25* 7.3/ft.	23 4.3/ft. 38* 7.1/ft.	22 3.7/ft. 38* 6.3/ft.	30 3.8/ft. 52* 6.5/ft.	No available data
8. EFFICIENCY LUMENS PER WATT	Overall—40.3	1" (tube only) 37	Lamp only 52.5 Overall 44.0	Lamp only 52.5 Overall 39.0	60 56*	61 57*	64 62*	65 63*	No available data
9. STROBOSCOPIC EFFECT	Very Slight	Requires consideration	Very slight	Very slight	2-lamp—very slight				Unknown
10. AVAILABLE EQUIPMENT	Industrial and commercial unit	Custom Built	Wide selection of commercial and industrial equipment	Limited selection of commercial and industrial equipment	None available to date				None available to date
11. DEPRECIATION OF OUTPUT	Colovolt claims 14% at 8000 hr. Other data 25% at 8000 hr.	20–25% at 8000 hr.	24%—4000 hr. 30%—6000 hr.	24%—4000 hr. 30%—6000 hr.	No definite data				No definite data
12. LIFE	8000—10,000 hr.	8000–10,000 hr.	2500–6000 hr. based on number of starts	2500–6000 hr. based on number of starts	2500–6000 hr. based on number of starts. data on 0.1 amp. operation			2500 hr. only	No definite data
13. POWER FACTOR	90–99%	85+% Must meet P.S.C. minimum	97%	90–95%	95% 1 and 2-lamp ballast				No definite data
14. TYPE OF CATHODE	Cup or shell	Cup or shell	Filament	Filament	Filament				Filament
15. METHOD OF EMISSION	High voltage	High voltage	Heated filament	High voltage start Heated operation	High voltage start Heated operation				High voltage
16. TYPE OF BALLAST	2-lamp	High voltage (single)	2 lamp	2 lamp	2 lamp				High voltage (single)
17. STARTING VOLTAGE	750	3000–15,000	208+ — 4' lamps	450–500	450	600	600	700	Probably 3000–15,000
18. OPERATING VOLTAGE	430–460	3000–15,000	108 — 4' lamps	108	170 145*	270 230*	245 215*	335 290*	Probably 3000–15,000
19. LAMP REPLACEMENT	Stock for straight Special for bends	Usually special bends	Stock	Stock	Stock for straight				Stock for straight
20. WHO MAINTAINS LAMPING	Straight tubes—anyone. Bends by tube man	Usually tube man	Anyone	Anyone	Anyone				Unknown. Probably anyone
21. PRESENT STATUS ELECTRICAL INSPECTION BUREAU	2-lamp—O.K. without special permission	Requires special permission electrical inspector							May require special permission

*Lamp only—Refer to manufacturers for ballast data. †Calculated values.

Red Lead "Soaps"

help make Paint Film Tough...Flexible...Water-Resistant

While maintenance engineers know, by long experience, that Red Lead helps *make metal last* . . . and widely accept it as the standard metal protective paint . . . it remained for modern science to show exactly *why* Red Lead so effectively inhibits rust.

One of the important reasons is Red Lead's ability to react with the vehicle, and produce unique lead "soaps."

These soaps grow to form a tough, impervious, intermeshing matrix within the paint film, as shown in the photomicrograph at right.

The soap formations increase Red Lead's protective power in several ways. For one thing, they *mechanically* reinforce and toughen the paint film.

At the same time they contribute all-important flexibility, allowing movement all along their soft, intertwining projections. This helps prevent the ruptures to which a hard unyielding film is subject.

Moreover, lead soaps slowly form primarily in the dry paint film as it ages. This is where the soap formations impart their greatest benefits. When a paint film weathers and ages, decomposition products of the vehicle are formed. Red Lead's ability to slowly combine with these decomposition products actually enhances the life of the paint film. Red Lead's slow rate of reaction means the film age-hardens at a slower rate. It thus retains a high degree of flexibility, a great factor in its lasting adhesion.

And again, the very structural formation of the soaps, with their dense, impermeable matrix of interwoven fibres, helps to restrict the passage of moisture through the paint film. Metal cannot rust without the presence of moisture.

Specify RED LEAD for ALL Metal Protective Paints

The value of Red Lead as a rust preventive is most fully realized in a paint where it is the only pigment used. However, its rust-resistant properties are so pronounced that it also improves any multiple pigment paint. No matter what price you pay, you'll get a better paint for surface protection of metal if it contains Red Lead.

***This photomicrograph** shows the distinctive lead soap formations resulting from Red Lead's reaction with the vehicle. Note how the rod-like projections, radiating from central cores, spread out and intermesh. This makes a strong, flexible, interwoven structure, just as individual fibres in a piece of cloth are woven to make the cloth strong and durable. This type of soap formation is unique with lead paint films.*

***Here you see** the standard apparatus used for measuring the water permeability of paint films.*

With this equipment a measure of the amount of water that passes through a unit of film is obtained.

Experiments show that a straight linseed oil film allows three times as much water to pass through the film as when the same film is pigmented with Red Lead . . . illustrating once more the beneficial protective action of Red Lead and Red Lead "soaps."

Write for New Booklet—"Red Lead in Corrosion Resistant Paints" is an up-to-date, authoritative guide for those responsible for specifying and formulating paint for structural iron and steel. It describes in detail the scientific reasons why Red Lead gives superior protection. It also includes typical specification formulas. If you haven't received your copy, address nearest branch listed below.

* * *

The benefit of our extensive experience with metal protective paints for both underwater and atmospheric use is available through our technical staff.

NATIONAL LEAD COMPANY: New York 6; Buffalo 3; Chicago 80; Cincinnati 3; Cleveland 13; St. Louis 1; San Francisco 10; Boston 6, (National Lead Co. of Mass.); Philadelphia 7, (John T. Lewis & Bros. Co.); Pittsburgh 30, (National Lead Co. of Pa.); Charleston 25, W. Va., (Evans Lead Division.)

Dutch Boy
Reg. U. S. Pat. Off.
Red Lead

CHART DETERMINES LINE VOLTAGE DROP

Calculating chart simplifies calculation of sending-end voltage and line drop for single- and three-phase transmission lines.

N. E. DILLOW,* Engineering Department, Central Illinois Public Service Co., Springfield

With conductor size, equivalent spacing and power factor known, curves yield correction factor for use in simple formula to determine line voltage drop and sending voltage when receiving voltage and line current are known.

•

Example

3Φ line, No. 1/0 copper, 2 miles long

Equivalent Spacing = 2.24 ft.

150 kw. at 80% p.f.

V_r = 2300 volts

$$I = \frac{150}{\sqrt{3} \times 2300 \times 0.8} = 47 \text{ amp.}$$

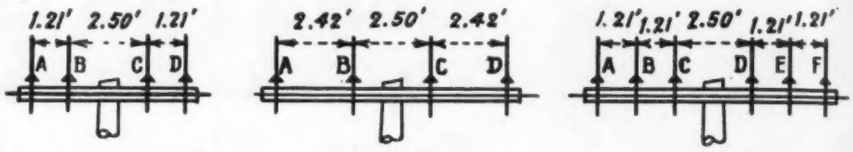
$$V_s = 2300 + (47 \times 0.607 \times 2 \times 1.43 \times \sqrt{3})$$

V_s = 2300 + 141

V_s = 2441 volts

* On military leave.

EQUIVALENT SPACING OF LINES



4-pin, 5-ft. 7-in. arm Equivalent Spacings		4-pin, 8-ft. arm Equivalent Spacings		6-pin, 8-ft. arm Equivalent Spacings	
ABC	2.24 ft.	ABC	3.09 ft.	ABC	1.52 ft.
ABD	2.81 ft.	ABD	4.44 ft.	BCD	2.24 ft.
				BCE	2.81 ft.

RELATIONS

Given: Receiving Voltage

Find: Sending Voltage

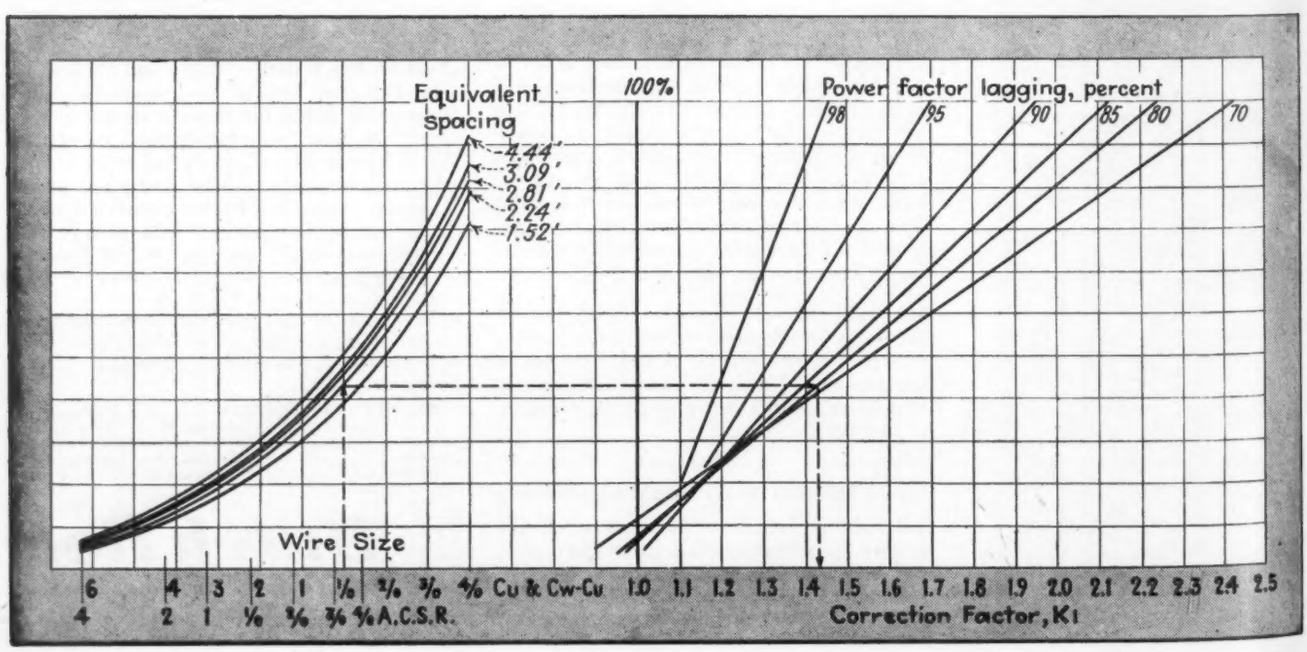
$$V_s = V_r + (I \times R \times D \times K_1 \times K_2)$$

Where:

V_r = Receiving voltage (line to line)
V_s = Sending voltage (line to line)
I = Line current
R = Resistance in ohms per mile or per 1,000 ft.
D = Distance in miles or 1,000's of feet.
K_1 = Correction factor taken from curve which evaluates effect of conductor spacing and power factor.
K_2 = Constant depending on type of system:
= $\sqrt{3}$ if system is 3-phase.
= 2 if system is single-phase.

CONDUCTOR RESISTANCE

Wire Size	Resistance at 50 deg. C.	
	ohms/mile	ohms/1000 ft.
4/0 Copper	0.303	0.0584
3/0	0.382	0.0724
2/0	0.481	0.091
1/0	0.607	0.115
1	0.765	0.145
2	0.945	0.179
3	1.19	0.226
4	1.50	0.284
6	2.39	0.453
4/0 ACSR	0.592	0.112
3/0	0.723	0.137
2/0	0.895	0.169
1/0	1.12	0.212
1	1.38	0.261
2	1.69	0.320
4	2.57	0.487
2A CwCu	0.978	0.185
4A	1.54	0.292
6A	2.44	0.462



for your rural line construction this spring...

OLIVER POLE LINE MATERIALS

From the complete line of Oliver Pole Line Materials you can select items designed and made specially for rural line construction. Some of these are illustrated below. A half-century of experience gives Oliver the knowledge needed for the manufacture of line materials that will have long life and give satisfactory service. See your Distributor.

POLE TOP PINS

The complete line of Oliver galvanized steel pole top pins includes straight and offset types, all commercial sizes, and various designs. The pressed steel type is shown here.

INSULATOR PINS

The pin illustrated is forged in one piece from mild steel, and is free from laps, seams and welds. Square wrench shoulder facilitates lining-up insulator groove. Other types are available as required for various services.

INSULATED CLEVISES

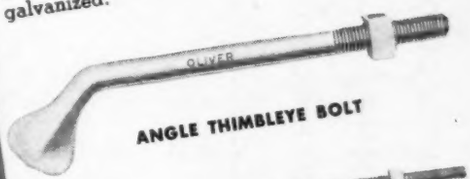
The wide variety of Oliver Clevises offers styles for every type of application and kind of construction. Styles include eye, split, swinging and plain types. Insulators are of either wet or dry type porcelain. Open hearth steel is used, hot dip galvanized.

GUY CLAMPS

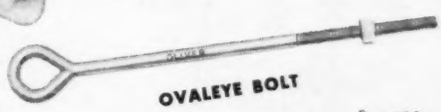
Light, medium and heavy types for one to four bolts. Straight, smooth, parallel grooves offer greater clamping area.

BOLTS

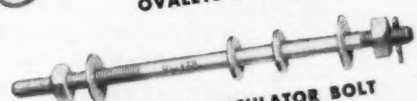
All types of bolts required for line construction are made by Oliver. Some of the more popular types are illustrated below. Features of Oliver bolts are: accurate dimensions, speed points, clean threads, hot dip galvanizing. Oliver nuts likewise are accurately made and tapped, and galvanized.



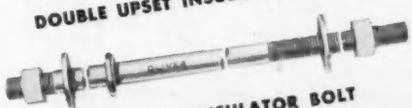
ANGLE THIMBLEYE BOLT



OVALEYE BOLT



DOUBLE UPSET INSULATOR BOLT



SINGLE UPSET INSULATOR BOLT

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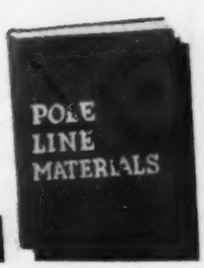

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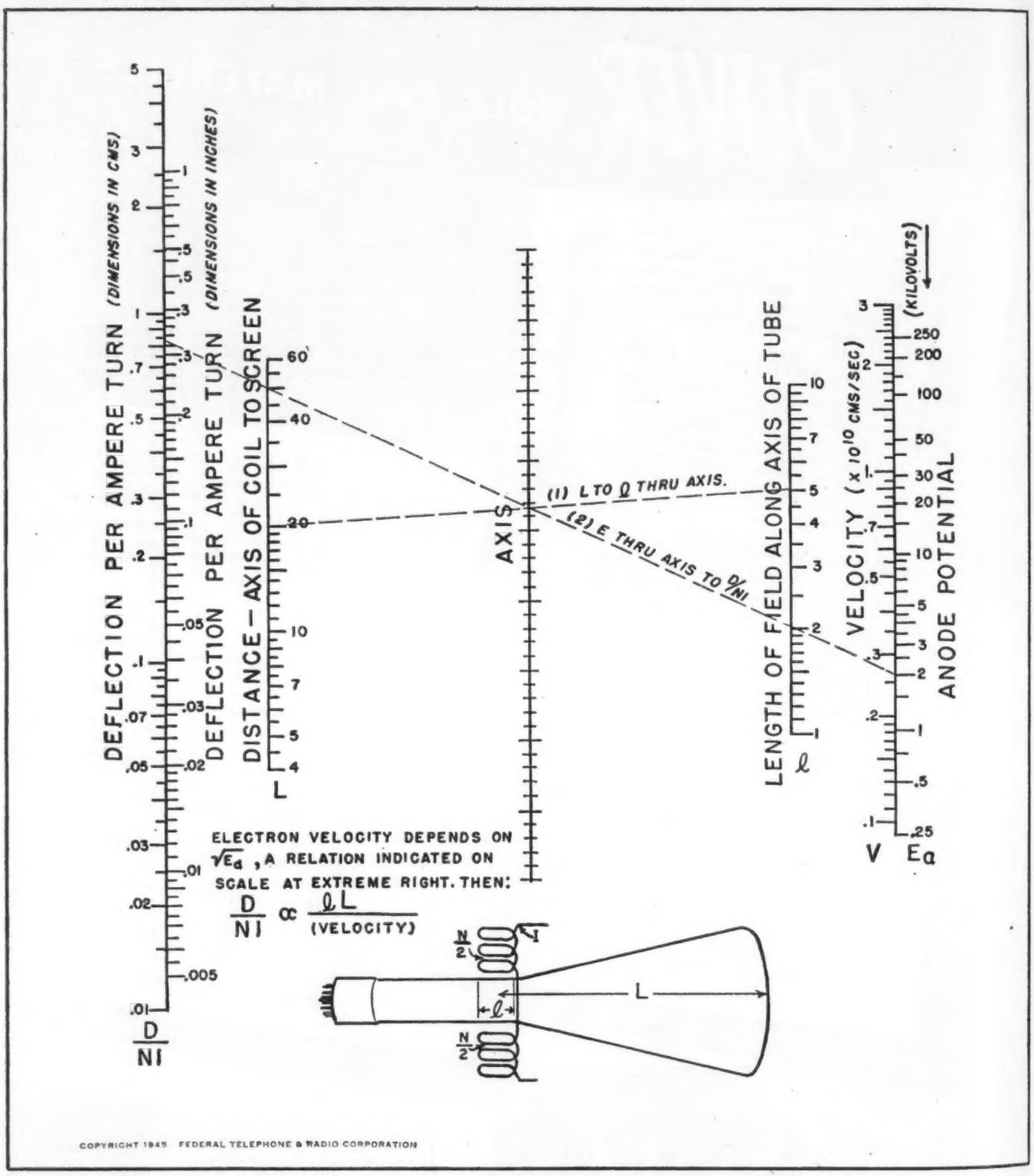
Deflection Sensitivity of Cathode Ray Tube Electromagnetic Deflection

(with corrections for velocity of electrons)

N. MARCHAND, Engineer, Federal Telephone and Radio Corp., New York



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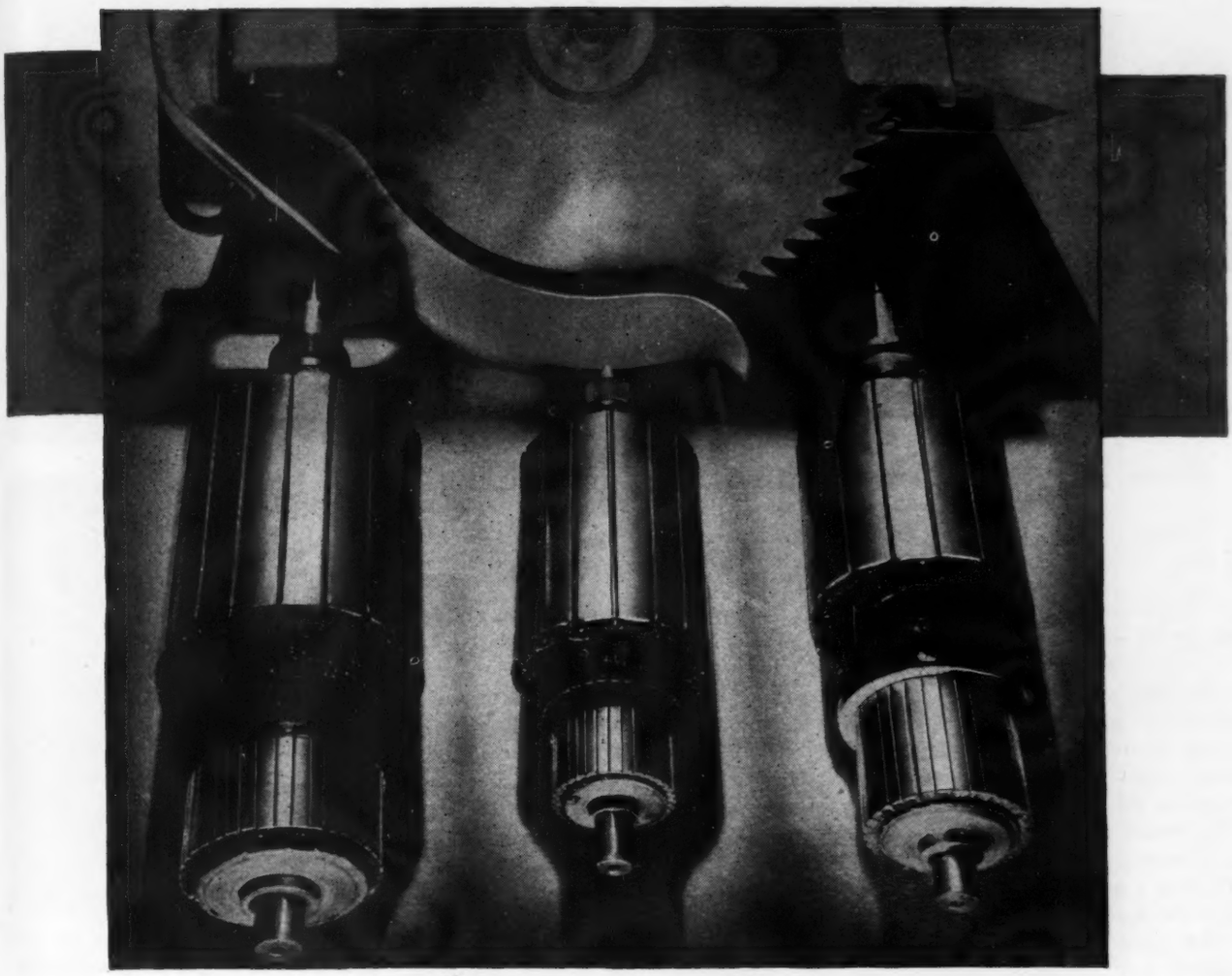
The electromagnetic deflection sensitivity of a cathode ray tube cannot be determined with accuracy owing to difficulty of computing intensity and dimensions of magnetic field. With no flux leakage $H = 0.04 \pi NI$, and the approximate deflection can be determined from chart, as indicated. The deflection per ampere turn scales (for use when dimensional systems are in centimeters and in inches) are at left. The scale at right shows electron velocity resulting from a given anode potential.



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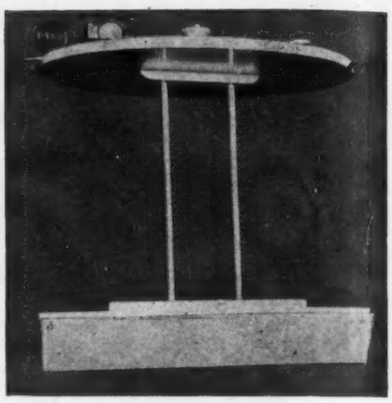

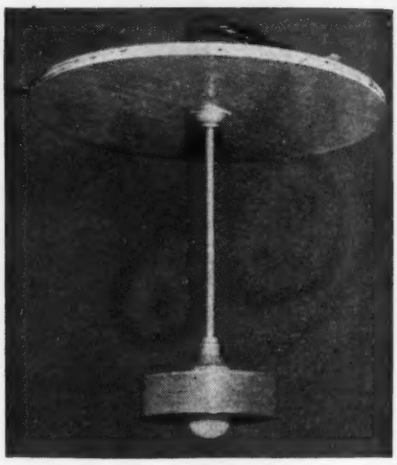

REMOVABLE FIXTURES—Two of the several different types of lighting fixtures used with the model are shown, above. Incandescent "200-watt" luminaire uses 21-cp. automobile lamps with series resistors on 120 v. The "two-lamp 40-watt" fixture uses two 8-watt 12-in. F lamps. Fixtures are mounted on discs that fit into ceiling of model store

Store Model Depicts Lighting Fundamentals

CARL ZERSEN
Manager, Chicago Lighting Institute, Chicago, Ill.

A "double-barreled" store model capable of several complete changes in lighting arrangement has been built by the staff of the Chicago Lighting Institute to add a note of realism to lectures on store lighting fundamentals before retail and trade association groups in the Chicago area. Design of the model was by E. D. Tillson of The Commonwealth Edison Co.

Built to a quarter scale—3 in. equal 1 ft.—the model is "double barreled" in the sense that it comprises two identical compartments furnished as grocery stores, each representing a store 25 ft. wide, 40 ft. deep and 12 ft. high. This two-compartment design is particularly effective in presenting a series of progressive improvements in store lighting since it allows the lecturer to contrast each improvement with conditions that preceded it. From the standpoint of stage-management of the lecture, the two compartments permit the lecturer to continue with discussion of one type of lighting arrangement while the next is being prepared behind closed curtains.

Eight different lighting arrangements can be displayed with the model. Each change carries with it a significant lesson in store lighting that the lecturer can point up by means of the model. These various arrangements, in the order that they are presented in most lectures, are:

1. Incandescent lighting; "200-watt" lamps in eight pendant fixtures on 10- by 12-ft. spacing; 15 footcandles, 1,600 watts "installed."

2. Glass shielded fluorescent; two "40-watt" F lamps in eight pendant fixtures of triangular section; same spacing, same intensity, half previous wattage "installed" counting ballasts.

3. Sames as (2) with fixture axis parallel to store traffic lanes instead of across traffic as in (2).

4. Same as (3) with fixtures ceiling mounted.

5. Raw two-lamp "40-watt" fixtures unshielded, mounted directly on ceiling on 10- by 12-ft. spacing across traffic lanes; still "800-watts installed," but 22 footcandles.

6. Glass shielded fluorescent fixtures of rectangular section housing four "40-watt" F lamps; eight luminaires on 10- by 12-ft. spacing, ceiling mounted; 1,600 watts "installed," 30 footcandles.

7. Sames fixtures as (6) in continuous rows parallel to traffic lanes—twelve in all—2,400 watts installed, 50 footcandles; supplementary incandescent down light over island displays; under shelf lighting and val-

TWO-COMPARTMENT STORE MODEL—Built by the Chicago Lighting Institute to depict fundamental principles of store lighting, this quarter-scale model portrays eight different lighting arrangements. Two identical compartments allow comparison of different lighting effects in a grocery store 25 ft. wide, 40 ft. deep and 12 ft. high

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1. **Shows Levels of Lighting on dial face in simple A-B-C-D-E readings.**
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5. **Shock-resistant—zero corrector sets at zero if thrown out of calibration.**
6. **Can be used for vertical or horizontal reading.**
7. **Special mat white finish on dial. Will not turn yellow with age.**
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9. **Comes individually boxed.**

Westinghouse Lamps

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ance lighting to silhouette signs on island.

8. Translucent store front sign, lighted from rear by row of fluorescent lamps; window display lighted by same lamps.

Technical details by which some of these effects are achieved in the model are of passing interest. To portray a narrow, deep store in a shallow model, a mirror was extended across the back of each compartment, producing the illusion of a 40-ft. store with a model "20 ft." deep to scale. To render lighting fixtures interchangeable, they are mounted on plywood discs 1 ft. in diameter that can be set in the ceiling and turned in any desired direction. To simulate incandescent lamps, 21-cp. 6-8-v. auto lamps with series resistors are used on 120 v. The 40-watt fluorescent lamps are simulated by 8-watt 12-in. F lamps. Auxiliaries for the fluorescent lamps are on top of the discs to which the units are attached and connected by cord and plug to a central plug board. The valance across the front of the model is high enough to "cover" backstage activity in changing fixtures.

Finally, to facilitate the use of the model before large audiences all of which may not be able to see the interior advantageously, the model is mounted in the center on ball bearing trunnions so that it can not only be swung from side to side but tilted forward as well.

The model was "unveiled" early this year at a meeting of the Radio and Appliance Dealers Group of the Chicago Electric Association and since then has played before many other Chicago retail groups.

• • •

Infrared Dries Pottery Before Firing

PAUL H. KRUPP
Fostoria Pressed Steel Corp., Fostoria, Ohio

"Waste" heat from the kilns is commonly used in potteries for drying the ware before it is fired. But even though such heat is "free," over-all production cost may be less if that heat is actually let go to waste and comparatively expensive electric heat used instead. That is the case in the plant of the Buffalo Potteries Co., Buffalo, N. Y., where infrared lamps are used for drying.

The installation (see accompanying illustration) has a connected load of 56 kw. consisting of forty-eight 500-watt and thirty-two 1,000-watt lamps, arranged on 11-in. centers. The 18-ft. infrared oven has resulted in a decrease in drying time from 90-150 minutes to 13 minutes. It is significant that a previous homemade infrared installation at Buffalo Potteries used 72 kw., and the new oven points up the value of an installation designed by qualified infrared engineers.

After the ware has been formed by an automatic jigger, it enters the infrared oven automatically on a conveyor. The front end of the oven is equipped with 1,000-watt lamps. This is believed to be the first time 1,000-watt lamps have been applied practically to an industrial drying job. In the remaining part of the oven 500-watt lamps are used.

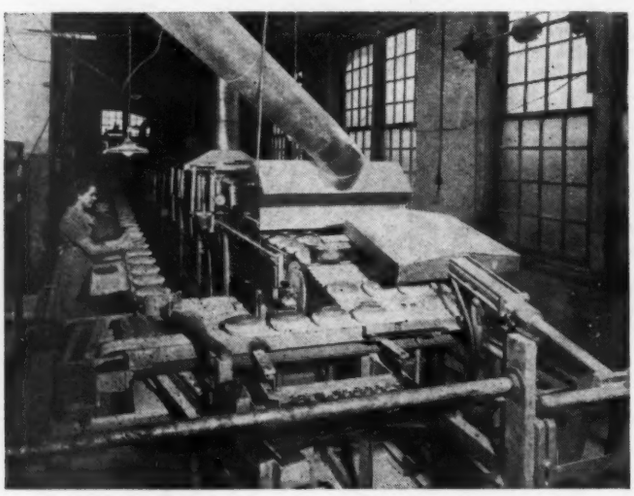
There is a tremendous saving in mould costs with infrared. With an average production of 100 dozen pieces of ware per hour, 30 dozen moulds are required. With the previous method, between 150 and 200 dozen moulds were required.

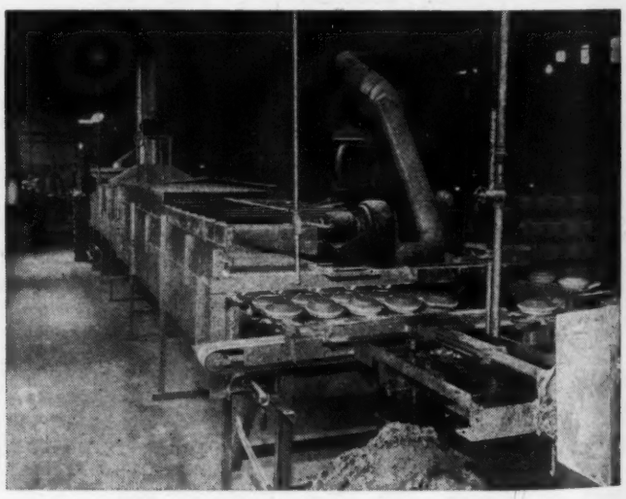
Experience shows that infrared results in less warpage, when properly designed reflectors are used for distributing the energy. Moulds do not become saturated after continuous use. After a 16-hour operation the ware is as dry as that which is obtained during the first hour.

With the infrared method, pieces that have an unsound internal structure will crack in the dryer, i.e., foreign matter such as wood, plaster, dirt or air blebs inside the piece will be disclosed. This feature is quite advantageous since it reduces the number of defective pieces which normally would be kiln fired before the defect might show up.

The fact that, in approximately 1,000 hours of operation up to the writing of this article, there has not been a single lamp failure is convincing evidence of the freedom of the installation from operation or maintenance troubles.

Although "waste" hot air is still used in the last section of the oven, no figures are available to indicate what percentage of moisture removal it can claim. The most casual observer will gather that the operating cost of this oven is relatively low, remembering too that only two people are required for its operation.





INFRARED proves its economy in drying pottery. Left and right, in and out ends of oven; 500- and 1,000-watt lamps used

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NEW EQUIPMENT

New Connector Operates 25 Deg. Cooler than Cable

New connecting device, called the Williams Grip electrical connector, is reported applicable to isolators, potheads, portable generators, switchboard test circuits, cable splicing, transformer connections, substation transfer connections, etc.

AiResearch Mfg. Co., 9851 Sepulveda Blvd., Los Angeles 43, Calif., manufacturers of the product, report that tests show a 1.9-millivolt drop at 100 amp. and that with 100 percent overload the connector operates up to 25 deg. F. cooler than the cable.

Pressure for the contact is obtained by tightening one-quarter turn, which is said to cause a gripping action along the entire contact area. This is reported to result from the action of a special thread on the male and female sections of the connector. The devices are insulated to withstand 600 volts.

•

2-Hp. Motor Designed To Fit Into Small Space

An extra-compact and light 2-hp. explosion-proof motor has been developed for continuous duty by Electrical Engineering and Mfg. Corp., 4606 West Jefferson Blvd., Los Angeles.

The motor is designed for railroad, marine, aircraft, and special industrial applications. An aircraft type, with armature speed of 9,000 rpm., this motor is available for any output-shaft speed with an integrally built gear reducer, supplied where lower speeds are required. This adds 2 lb. to the basic weight of 15 lb.

Enclosure is said to make the motor safe for use in hazardous locations. In addition, because of its compactness, it is said to be suited to such applications as fan and blower, pump, winch, and other drives, where continuous-duty horsepower must be fitted into small space.

It is completely insulated with glass insulation and high-temperature varnishes and can therefore be operated in continuous duty with a temperature rise of 75 deg. C., over an ambient temperature of 25 deg. C. It can be supplied for operation on 28, 32, or 110 volts, d.c.

•

Carbon Brushes for High Peripheral Speeds

Series 8880 high-speed carbon brushes is an addition to the Morganite Brush Co., Inc., 3302 48th Ave., Long Island City 1, N. Y. line of electrographic brush grades. Known as Grade Link EG/8870, Link EG/8866 and Link EG/8880, they were developed to meet the trend toward higher peripheral speeds and higher current densities.

Efficiency of collection and riding stability are reported as obtained by the "open" texture of the brushes. Link EG/8880 is the more open in texture of the three, EG/8870 is closest in texture, and EG/8866 lies between.

Fog Nozzle Developed For Fixed Installations

A new fire control nozzle for fixed installations, constructed in such a manner that it produces a fog, is announced by the Blaw-Knox sprinkler division, Pittsburgh, Pa., for use in connection with its various fire control systems. The nozzle, which has been named the Aquatomic Fog Nozzle, is reported as adaptable to the protection of tanks containing flammable liquids, either in tank farms or housed in buildings.

Fog is produced by forcing water through three spiral passages and a central passage in the head of the nozzle. The pattern is said to be maintained at reduced water pressures.

It is reported as adaptable to the chemical, electrical, and petroleum industries. In the electrical industry, it can be used to extinguish fires in oil-immersed switch gear and oil-filled transformers on manually or automatically controlled systems.

•

Farm Welder Draws 25-Amp. Maximum Input

A new low cost farm welder incorporating the company's multi-range dual welding control has been developed by The Hobart Brothers Co., Troy, Ohio, for operation on 230-volt single-phase rural power lines with a maximum input of 35 amp. to conform to rural electrification requirements for this type of welder. This farm welder, which can be used with the standard 3-kva. transformer as provided by the utility, has a welding range of 20 to 180 amp. and utilizes electrodes ranging from $\frac{1}{16}$-in. to $\frac{5}{32}$-in. diameter. Current adjustment is accomplished in 30 spaced steps by the use of the hand wheel on front of the cabinet, and smaller adjustments can be obtained with the switch in center of this hand wheel, which also functions to disconnect the welder from the power line.

Striking voltage increases as welding cur-

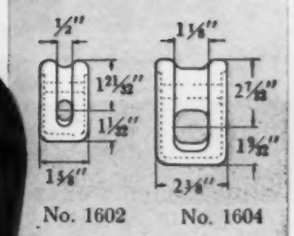
30 years of Proof!

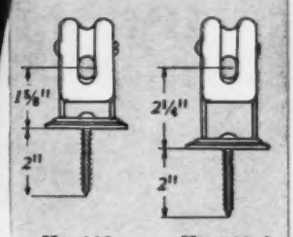
HUBBARD No. 190 WIREHOLDER

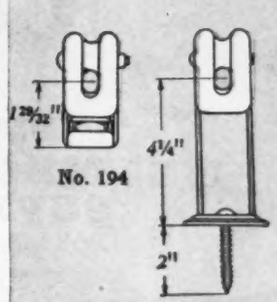
For more than 100 years, Hubbard and Company has enjoyed the privilege of serving industry with its greatly diversified products of the durable goods class.

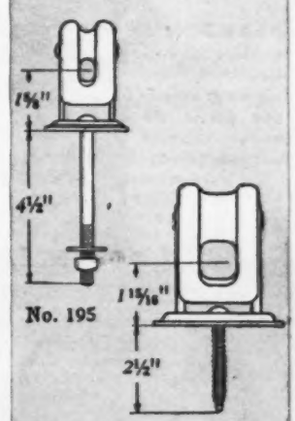
During the latter half of this century of service, the most notable group of materials has been a complete line of Pole Line Hardware, and for more than thirty years, Hubbard No. 190 Wireholders have been produced in quantities reaching well into the millions.

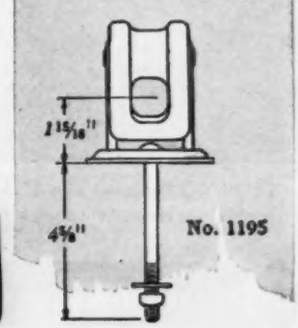
This old, reliable design with its variations shown here, is the favorite of many engineers and linemen from coast to coast. They know, that in thirty years of service, the Hubbard No. 190 has encountered every hazard to which a wireholder may be exposed. They know it has a slender pointed, full threaded screw for easy starting and maximum holding power in sheeting or solid wood. They know that its strength is much greater than that of the average service wire. They have discovered that this strength is due to the fact that the porcelain insulator is in compression with metal supports, not in tension, which is the weakest state of porcelain. They have thirty years proof that the Hubbard No. 190 has what they want in a wireholder.











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190-A	1602	No. 22 x 2 Wood Screw	2-1/4	9/16 x 3/4	115
190-R	1602	No. 22 x 2 Wood Screw	4-1/4	9/16 x 3/4	150
194	1602	5/8 Tap	1-29/32	9/16 x 3/4	95
195	1602	3/8 x 4-1/2 Carriage Bolt	1-5/8	9/16 x 3/4	140
1190	1604	No. 24 x 2-1/2 Wood Screw	1-15/16	1-1/8 x 1-1/8	228
1195	1604	3/8 x 4-5/8 Carriage Bolt	1-15/16	1-1/8 x 1-1/8	240

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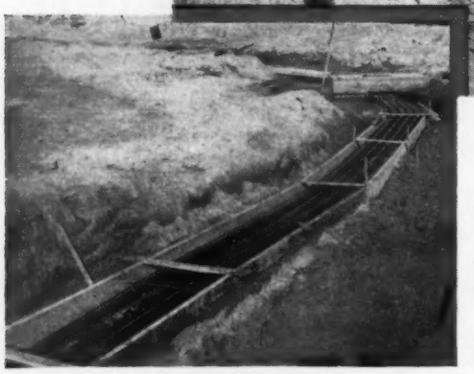
BERMICO'S quick and easy installation and low water absorption permit use under adverse wet conditions.



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BERMICO'S flexibility, plus 5° Angle Couplings enable you to meet unusual field conditions.

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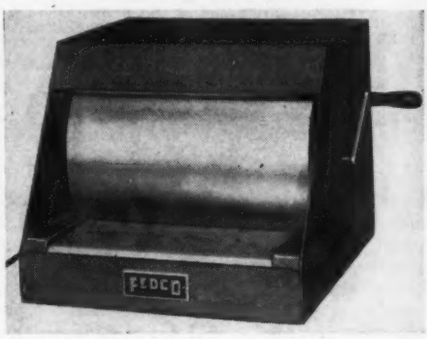
rent is reduced, which is reported to make it easy to start and maintain the arc under all conditions. The design eliminates the use of special devices such as relays and contactors. A capacitor is included for power factor improvement.

Among the features reported are the laminated transformer core of high-grade silicon transformer steel, use of glass insulation throughout, cabinet of pressed steel arc welded into one piece, efficiency at maximum load approaches 86 percent, large casters and light weight (224 lb.), which make for easy portability.

•

Print Dryer Heating Element Formed in Rotating Element

Dryer for blueprints, copy prints, and photostats, manufactured in motor driven and hand driven models, has been an-



nounced by Fedco Products Co., 37 Murray St., New York City.

With the exception of the duck belt, it is all metal. It utilizes a 300-watt heating element with the resistance wire especially shaped to fit the contour of the inner drum surface. The manufacturer reports that a newly developed device enables the current to reach the heating element without the use of slip rings.

The dryer may be used on 115-volt, a.c. or d.c. circuits. It occupies 18 x 18 in. of bench space and necessitates 15 in. of head room.

•

High-Power Triode Announced by Taylor

Announcement of an improved 833A transmitting triode in the high-power classification was made recently by Taylor Tubes, Inc., 2312 Wabansia Avenue, Chicago, Ill. Similar to the conventional 833A, the new tube contains a zirconium-coated anode with the zirconium coating sprayed only on that part of the plate which is most subject to heat during operation.

Maximum signal outputs are: as Class B modulators (pair)—2,700 watts; as RF Class B amplifier, telephony—250 watts; as RF Class C amplifier, plate-modulated—1,500 watts; and as RF Class C amplifier, telegraphy—1,600 watts.

Physical dimensions: Diameter—$4\frac{1}{32}$ in. max.; Height—$8\frac{1}{8}$ in. Grid and plate caps at top: $\frac{5}{8}$ in. long by 0.567 in. diameter. Two filament caps at bottom: each $1\frac{3}{32}$ in. long by $\frac{3}{8}$ in. diameter.

Electrical characteristics: Filament (thoriated tungsten) 10 v. (a.c. or d.c.) at 10

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"Our Line Maintenance Wins Praise —thanks to Ford Stamina and Service"

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Mr. F. E. Fair, manager of the Eastern Iowa Light & Power Cooperative, Davenport, Iowa, wrote some time ago: "*The performance and reliability of our Ford fleet enable us to render good service to some 5100 food-producing farms through seven counties. We've been complimented several times for the speed with which line breaks are repaired during severe storms when rural roads are difficult to travel.*"

There are many new and important engineering advancements in the new Ford Trucks—designed to bring you still greater economy, reliability, long life. Get the full facts from your Ford Dealer.

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Easier Servicing

A STILL GREATER 100 HP V-8 ENGINE with NEW Ford steel-cored Silvaloy rod bearings, more enduring than ever in severe service • NEW aluminum alloy cam-ground 4-ring pistons for oil economy • BIGGER, more efficient oil pump and IMPROVED rear bearing oil seal • NEW longer-lived valve springs • NEW improvements in cooling • NEW efficiency in ignition • in carburetion • in lubrication • in ease and economy of servicing operations • And available in all truck chassis except C.O.E. units—the rugged, thrifty 90 HP FORD SIX-CYLINDER ENGINE, with many important advancements.

FORD CHASSIS ADVANTAGES: Easy accessibility for low-cost maintenance • Universal service facilities • Tough, forged front axles • Extra-sturdy rear axles with pinion straddle-mounted on 3 large roller bearings, ¾-floating type in light duty units, full-floating in all others • 3 axle ratios available (2 in 1-ton unit) • 2-speed axle available in heavy duty units at extra cost • Powerful hydraulic brakes, large drums, cast braking surfaces • Rugged 4-speed transmission with NEW internal reverse lock optional at extra cost on light duty units, standard on all others.

FORD TRUCKS

MORE FORD TRUCKS ON THE ROAD • ON MORE JOBS • FOR MORE GOOD REASONS

SKILLED HANDS TURN OUT SUPERIOR INSULATORS AT Victor

...BIRTHPLACE OF THE FIRST WET PROCESS HIGH VOLTAGE INSULATORS

Below — An "old hand" is shaping an insulator with a jigger tool.

FOR MORE than half a century craftsmen in Victor community have fashioned hard, tough high-tension porcelain insulators. Victor artisans take pride in their skills. Insulators produced at Victor are unexcelled for quality, accuracy of dimensions, true shapes and appearances . . . For safety and satisfaction look for the Victor "V" on the insulators you order.

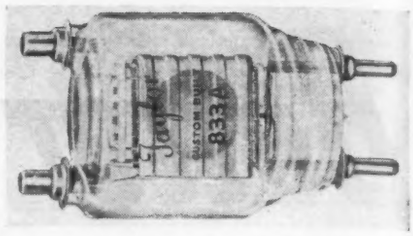
SEND FOR FREE BOOK
"A Story of Victor" tells how insulators are made. 24 pages. Write for your copy.

Above—Turning out a corrugated bushing of special design for an electrical apparatus manufacturer.

Right—Cutting corrugations in a multipart insulator.

V VICTOR INSULATORS, Inc.
VICTOR, NEW YORK

The MARK of GOOD INSULATORS



amp. Amplification factor: 10. Inter-electrode capacitance: G-F 12.3 mmf.; G-P 6.3 mmf.; P-F 8.5 mmf.

Typical key-down conditions per tube, Class C, RF amplifier and oscillator: (ICAS ratings with forced air cooling) d.c. plate volts—4,000 v.; d.c. grid volts—minus 225 v.; peak RF grid voltage—415 v.; d.c. plate current—0.5 amp.; d.c. grid current—95 ma. (approx.): driving power—35 watts; power output—1,600 watts; highest frequency for maximum ratings—20 mc.

•

Paper Carton Simplifies Compound Problems

Ozite "B" (insulating) compound is now available in a new type of package, a paper carton, G & W Electric Specialty Co., 7780 Dante Ave., Chicago 19, Ill., announces. The carton is stated to do away with the necessity of preheating, to eliminate waste and to make the compound more easily prepared.

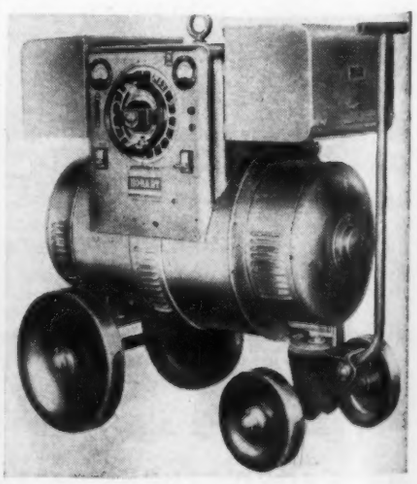
The compound for filling cable joints, potheads and boxes is available in 1-qt. cartons. A solid cake of compound ready for heating is obtained by removing the paper cover, slitting the side of the container with a knife, removing the bottom and peeling off the paper sides. The paper is reported not only not to adhere to the compound but to break away clean.

•

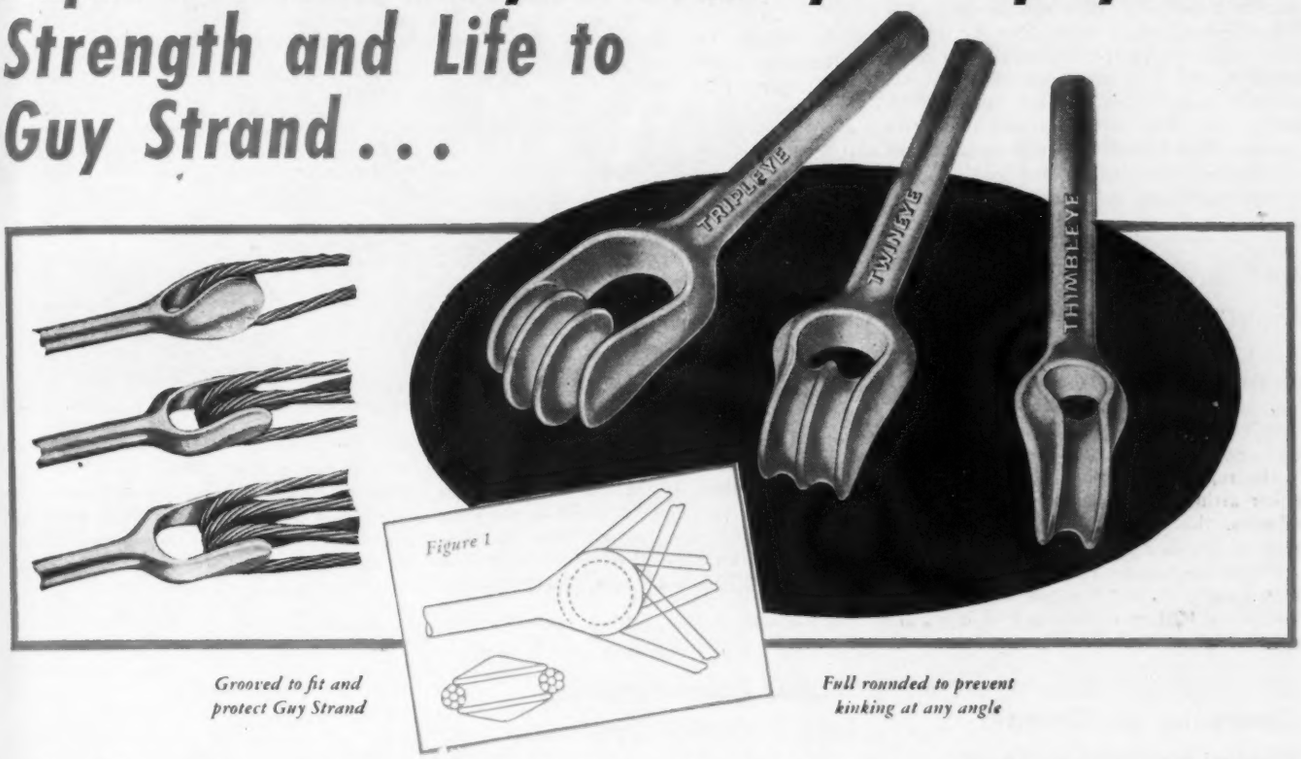
Welding, Battery Charging Done on Single Machine

A battery charger—arc welder combination for charging railway coach batteries and electric arc welding have been developed by The Hobart Brothers Co., Motor Generator Corporation Division, Troy, Ohio.

This dual purpose machine, although designed especially for the railroads, is re-



Improved Thimbleye • Twineye • Tripleye add Strength and Life to Guy Strand . . .



Grooved to fit and protect Guy Strand

Full rounded to prevent kinking at any angle

You will instantly recognize the change in Thimbleye, Twineye, and Tripleye anchor rods and guy fixtures as being a definite improvement in appearance and an added protection to guy strands. The streamlined appearance is the result of improvements designed to give more complete protection to the strand at varied angles of pull, the objective being to further minimize any hazards to line security caused by kinked, distorted, or broken strands of cable.

The improved eye is drop forged on the rod as a perfectly shaped thimble and the sidewalls and groove of the eye extend all the way around the head of the rod. (See Figure 1, above.) This keeps the strand from flattening under tension, preserves its natural roundness, and prevents it from kinking at any one point. All grooves conform, in depth and width, to the largest cable size used with each rod or guy fixture. Grooves are deeper and give better support to the guy strand.

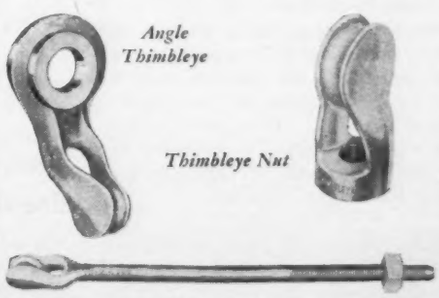
Always specify Thimbleye, Twineye or Tripleye rods and fixtures. Your nearest jobber can supply you.

THE NEW IMPROVED EYE:

1. ***MAINTAINS*** full support of guy strand at all angles.
2. ***PROTECTS*** strand and prevents flattening under tension or kinking on angle pulls.
3. ***PREVENTS*** injury to galvanizing and consequently rusting of guy strand due to kinks, bends, and breaks.
4. ***AIDS*** slacks pulling — guy strand passes through eye easily without kinking, bending, or binding.
5. ***ECONOMICAL*** to install and maintain.
6. ***IMPROVES*** appearance of any guying installation.

Thimbleye Guy Fixtures

Can be used singly or in a variety of combinations. Guy may be attached to fixture while lineman is on the ground and then mounted on the pole, slack being pulled on the ground at the anchor end.



C483

ABC INDUSTRIES

A·B·CHANCE CO· CENTRALIA, MO.

CHANCE IMPROVED THIMBLEYES MANUFACTURED AND DISTRIBUTED BY THESE LICENSEES:

Joslyn Mfg. & Supply Co., Chicago, Ill.
Line Material Co. . . . Milwaukee, Wis.
H. Slater . . . Canada
Kerrick Mfg. Co., San Francisco, Cal.
Seylar Mfg. Co. . . . Pittsburgh, Pa.

metal in 15, 20, or 25 line rulings. The smaller model (No. 102) mounts through a 1-in. opening, and is available in d.c. ranges from 0-100 micro-amperes through 0-10 milliamperes, and 0-50 millivolts. External accessories adapt them to other ranges. The larger (No. 152) mounts through a 1½-in. opening and is available self-contained in all standard d.c. ranges, and rectifier and thermocouple-type instrument.

•

Switch Plates Emit Light 8 Hours After Dark

Switch plates molded of a new luminous plastic material that is reported to have high light retention values is announced by Gits Molding Corp., 4600 West Huron St., Chicago, Ill.

The report states that, after exposure to either artificial or daylight for a period of minutes, the plate will emit a blue-white glow in the dark for approximately 8 hours.

Plates are made for toggle and push-button switches, for convenience outlets and for boxes having outlets and switches in combination.

•

Generator on Charger Piloted on Engine Shaft

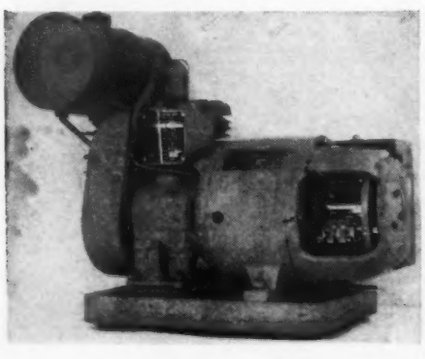
Battery-charging engine generator set using a Briggs & Stratton engine and having a capacity of 80 amp. at 6 volts has recently been developed by Kato Engineering Co., Mankato, Minn. It is also available with 12- and 32-volt generators.

The gas engine has a 2-in. bore, a 2-in. stroke, 1-gal. fuel tank, flat feed carburetor, and a gravity feed flyball governor which permits adjusting the charging rate.

The generator is bolted to the side of the engine crankcase. The drive end of the armature is piloted on the engine crankshaft. Greased sealed ball bearings carry the outer end of the armature.

Generator commutator is said to accommodate extra large dual brushes. There are four sets of brushes with two all-brass brush holders on each stud.

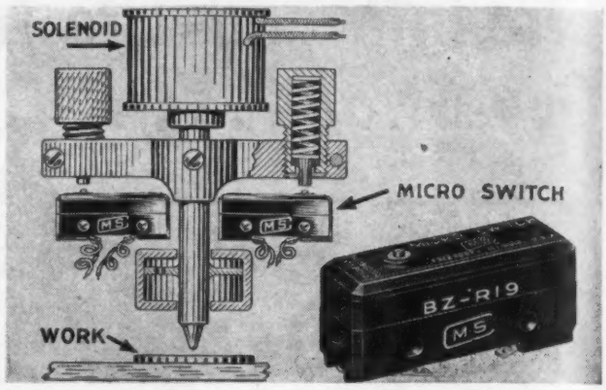
Each charger set is provided with a starting switch, ammeter, and a reverse current relay. Commutator and brushes are reported as easily accessible by removing the spun metal covering. The plant is self-cranking but, in event the batteries are too low, the engine can be hand cranked. The engine has magneto ignition.



New Part Sorting Switch Developed by Micro

A switch for the automatic sorting of small parts is a new development of the Micro switch division of the First Industrial Corp., Freeport, Illinois.

The accompanying illustration suggests one of the uses of the new snap-action switch. When the solenoid is deenergized, the plunger assembly descends by gravity under control of the air dash pot. The point at which the plunger is stopped by the work beneath determines whether neither switch or one or both switches are operated. A timer in the electrical circuit controlled by these switches operates an air blast to blow the work into "OK" or "Rejection" bins. Electric lamps may also be used for the indication of results.



This new switch (Model BZ-R19), interchangeable with other basic switches of the company's line, has a reported repeatable accuracy of 0.0001 in. This is said to make it applicable as a safety limit switch or in cycle control operations.

•

Linear Potentiometer Life, 1,000,000 Operation

A new line of wire-wound linear potentiometers consisting of three models, which have performance accuracies stated hitherto unobtainable in a single-turn potentiometer, is reported by Fairchild Camera & Instrument Corp., Jamaica, N. Y. For plotted performance, accuracies of 0.05 percent are provided in the largest, 5-in. diameter size, and 0.15 percent in the smallest, 2-in. size, the report states. Life is reported as greater than 1,000,000 cycles of operation while retaining initial accuracies.

The electrical angle of rotation is from 352 deg. to 357 deg., leaving a maximum unwound sector of 8 deg. in the smallest size and an unwound sector of 3 deg. where the maximum wound length is required. The potentiometers are reported to offer many possible general applications in simplifying circuit designs for precise control, either when used singly or ganged on a common shaft.

•

Hinged Seat Applies Breaks on Truck

A dual wheel, heavy duty platform type shop truck of 1-ton capacity for handling heavy material has been developed by the Buda Co., Harvey, Ill. It has a non-skid deck with a loading space of over 20 sq. ft. and is provided with dual wheels to carry the heavy loads.

Its construction features include an electrically welded reinforced steel frame. Spring cushioned seats with form-fit back rest contribute to operator's comfort. Simplified controls include hand lever for forward, reverse, and neutral. Steering is by one hand with convenient foot brake and accelerator. Seat cushion is hinged so that when operator leaves seat, brakes are automatically applied. The Model FF Chore Boy, due to its 1-wheel front steering, and overall width of 40 in., is easy to maneuver through narrow aisles, up and down ramps, onto platforms and loading decks and into box cars and trucks.

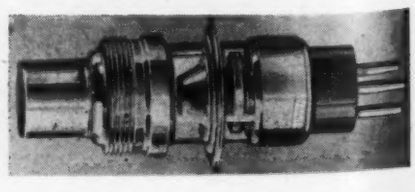
It is equipped with an air-cooled 7.7-hp. engine and is reported to develop speeds up to 15 mph. and to attain 35 to 40 miles per gallon of gas. It is equipped with a transmission of the simple friction type and with heavy duty roller chain drive to rear axle. Heavy duty pneumatic dual wheels are mounted on rear drive axle and bearings.

•

Reflex Klystron Features "Quick Change"

A new reflex klystron designed for operation at wavelengths between 6 cm. and 7 cm. has been announced by the research laboratories of Sylvania Electric Products Inc., Flushing, N. Y. Just out of the research stage, the tube design features "quick change" by means of threaded disc-seal electrode.

Typical operating characteristics of Type SD-835F Klystron include: 65 milliwatts power output at 6.1 cm.; 70 milliwatts power output at 7.0 cm.; beam current, 32 ma.; cavity voltage, 325 volts; heater voltage, 5.3 volts; and heater current, 1.1 amp. Maximum over-all length of the tube is 3.0 in.; bulb diameter, 0.75 in.; and diameter of grid disc, 1.125 in.

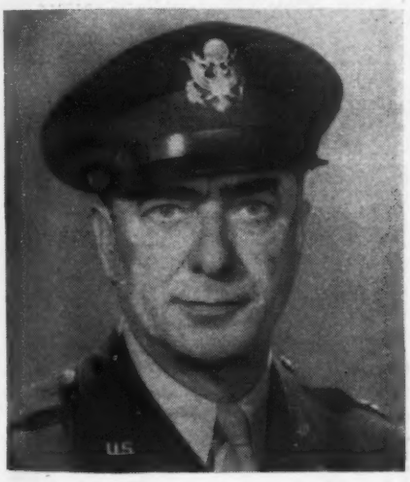


NEWS ABOUT PEOPLE

Pfeil Made Vice-President of Stone & Webster, Inc.

Col. John S. Pfeil, formerly with General Motors Corp., has been elected a vice-president of Stone & Webster, Inc.

Colonel Pfeil was associated with General Motors for many years and in several



J. S. Pfeil

capacities. Before entering the Army on military leave, he was manager of the Frigidaire Division in New England. During the war he was Deputy District Chief and Chief of the Industrial Division of the Boston Ordnance District and received the commendation ribbon with oak leaf cluster and the Legion of Merit for outstanding achievement in the production of war material. He attended Heidelberg University in Germany.

Colonel Pfeil will make his headquarters in Boston, but will be closely associated with the New York office of Stone & Webster, Inc.

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▶ FRANK M. TAIT, well-known public utilities executive and financier of Dayton, Ohio, has been appointed vice-chairman of the Thomas A. Edison Centennial Committee. Mr. Tait brings to this office a deep-seated interest inspired by early contacts with Mr. Edison. As a young man, in 1893, he worked with the inventor in pioneering a method of manufacturing pig iron in blast furnaces employing anthracite. He is chairman of the board of the Dayton Power & Light Co., a director of the Columbia Gas & Electric Corp., New York, and president of the Dayton Pump & Manufacturing Co.

•

J. C. Nichols New President of Rural Co-op Association

J. C. Nichols, who was recently elected president of the National Rural Electric Cooperative Association, has been a leader in the rural electrification movement for a number of years.

Mr. Nichols was 20 years of age when he migrated from his native Iowa to Cody, Wyo., in 1903. He got his start as a paper salesman in Chicago. Later he went into the lumber business and is now a large veneer manufacturer, with offices in Chicago.

He is also one of the world's largest ranchers.

Mr. Nichols became interested in the rural electrification movement on his travels around this and other countries. He became one of the incorporators of the National Rural Electric Cooperative Association.

•

▶ HOWARD T. STEWART of the Ketchikan Public Utilities, Ketchikan, Alaska, has resigned effective next July 1. Mr. Stewart has agreed to remain in office until the Beaver Falls power contract, designed to supply additional electricity to Ketchikan, is completed next spring. Mr. Stewart is planning to go into private business.

▶ ALBERT B. PATERSON, president of New Orleans Public Service, Inc., has been awarded the New Orleans Times-Picayune loving cup "in recognition of his 15-year record of civic services" to his community.

▶ A. U. ZIMMERMAN, former district manager for California-Pacific Utilities Co. at Benicia, Calif., has been recently appointed manager of the Lassen district to succeed M. D. McKenzie.

William McClellan Retires As Union Elec. Chairman

William McClellan retired as director and chairman of the board of the Union Electric Co. of Missouri at the recent annual meeting of stockholders. His age, 73, is the reason for his relinquishing the duties he assumed in December, 1941.

W. McClellan

Mr. McClellan has been associated with the company since May, 1939, when he was named president. Previously Mr. McClellan had been president of the Potomac Electric Power Co., Washington, D. C., from 1933 until 1939.

Obtaining his early experience from 1900 to 1907 with the Philadelphia Rapid Transit Co. and Westinghouse, Church, Kerr & Co., Mr. McClellan spent the succeeding 20 years as a member of the engineering firms of Campion-McClellan Co., Paine, McClellan & Campion and McClellan & Junkersfeld, serving also as consulting engineer for the New York Public Service Commission, and as dean of the Wharton School of the University of Pennsylvania. In 1925 he was selected by President Coolidge as a member of the Muscle Shoals Commission.

Mr. McClellan is a past-president of the American Institute of Electrical Engineers.

▶ JOHN P. CRUICKSHANK, of Huntington, W. Va., has been appointed superintendent of transmission and distribution of the Appalachian Electric Power Co. at Roanoke, Va.

▶ JAMES M. EVANS, California consulting electrical engineer, most recently electrical engineer with the U. S. Army Engineers, has been named supervising electrical and mechanical engineer for the Navy Bureau of Yards and Docks. In his new capacity he will have supervision over electrical and mechanical installa-

tions for the Navy in the 11th and 12th Districts which comprise California, Nevada and Utah.

▶ EARLE A. LEFEVER has retired as superintendent of the meter department of the Buffalo Niagara Electric Corp. after 43 years' service. He joined the company in 1903 as foreman of the two-man meter department.

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Ross Assumes Executive Responsibilities in Indiana

Announcement has been made of the appointment of P. Waldo Ross as vice-president and general manager of the Southeastern Indiana Power Co., Rushville, Ind.

P. W. Ross

A native of Indiana, Mr. Ross is well known in the public utility field in that state. His 20-year background with electric light and power companies in Indiana eminently qualifies him for his new executive position.

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▶ C. C. KING, assistant superintendent of the meter department of the Houston Lighting & Power Co., Houston, Tex., is the first to retire under the company's new retirement program. Mr. King has been with the company since 1910.

•

▶ GEORGE S. GROSSMAN, formerly district representative for the Rumsey Electric Co., Wilmington, Del., has been appointed commercial vice-president of the company with headquarters in Philadelphia. Mr. Grossman has been with Rumsey Electric for 35 years. Prior to that time he was affiliated with the E. I. DuPont de Nemours & Co., as construction manager.

▶ JAMES WINEGARDNER has been named superintendent of utilities in Hillsboro, Ohio, succeeding G. A. Dunnagan.

Executive Appointments Made by Joslyn Mfg. Co.

Joslyn Mfg. & Supply Co., Chicago, has announced the following recent changes in its organization.

R. B. MacDonald has been elected vice-president of the Joslyn Co. of Cali-

R. B. MacDonald

fornia and will direct all West Coast sales with headquarters in Los Angeles. Mr. MacDonald was formerly vice-president of the Joslyn Mfg. & Supply Co., a position that he resigned on Feb. 1, 1946, to accept his new responsibility. He joined the sales department of Joslyn

M. M. Kenneally

Mfg. & Supply Co. in 1922 and continued in this work until 1936 when he became vice-president in charge of sales.

M. M. Kenneally has been appointed sales manager of Joslyn Mfg. & Supply Co. with headquarters at Chicago. Upon graduation from Iowa State College with B.S. and E.E. degrees, Mr. Kenneally immediately entered the electrical industry. After 16 years of operating experience with American Gas Improvement Co. properties he joined Ohio Brass Co., subsequently becoming manager of its insulator division. He left Ohio Brass Co. some years later to become vice-president and sales manager of Porcelain Insulator Corp., Lima, N. Y. Mr. Kenneally has been associated with Joslyn Mfg. & Supply Co. for some time. In his new position as sales manager he will direct the sale of the company's entire line of materials for the electrical industry.

E. R. McCoy has been named assistant sales manager of Joslyn Mfg. & Supply Co. Mr. McCoy, who will have his headquarters in Chicago, was graduated from Purdue University in 1917 and immediately enlisted in World War I. On his return he entered the sales engineering field in Indianapolis where he confined his efforts to the sale of materials for public utilities. He joined the Joslyn Mfg. & Supply Co. in 1935.

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G. E. Sangster Joins Staff of Sangamo Electric Co.

Appointment of George E. Sangster as sales development engineer was announced recently by Sangamo Electric

G. E. Sangster

Co. Mr. Sangster has just returned from two and one-half years' service with the Navy, Bureau of Ships, Washington, D. C.

Prior to his enlistment, Mr. Sangster was valuation engineer with the Potomac Electric Power Co., with a 16-year service record. He is a native of Virginia, and a graduate of both Benjamin Franklin University, in business; and George Washington University, in electrical engineering.

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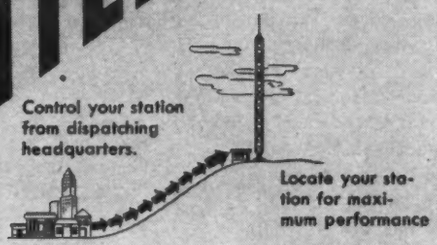
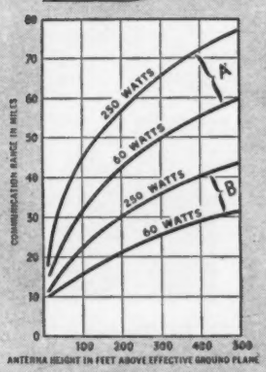
▶ JOHN W. CLEMENT has been named farm electrification head for the B. C. Electric Railway Co. Ltd., with offices in New Westminister. The agricultural development branch of B. C. Electric will operate throughout the Fraser Valley territory and will resume the activities which were closed down at the outbreak of war. Prior to joining B. C. Electric Railway

BETTER RADIO FLEXIBILITY

WITH THE *New* DE LUXE REMOTE CONTROL





Effect of antenna height and location on communication range. A applies to quiet residential and rural areas. B applies to high noise-level locations, such as congested or industrial areas. These curves are for estimating purposes only.

WHEN you plan your radio dispatching system *spot* your station equipment for maximum performance and minimum cost. Do it with one or more G-E De Luxe Remote Control units at dispatching headquarters. Give your dispatchers more than one control point for emergencies. For this service the G-E De Luxe Remote Control unit has outstanding features:

- Automatic level control assures proper modulation regardless of "speech habits". This feature reduces distortion, improves message reception.
- Desk-type, low-level microphone with pre-amplifier improves clarity of station messages.
- A complete FM receiver, with meter, gives positive indication of actual carrier level. Meter checks all receiver functions—receiver can be used in emergencies if station receiver fails.
- Second meter indicates outgoing voice level.
- Cyclometer-type electric clock facilitates log entries.
- Single-pair wire line meets all FCC and operational requirements. *Includes the G-E features of station receiver squelch adjustment from headquarters.*
- Line amplifier with mixing circuits, level-balancing controls, master gain control, and selector switches permit use of one or two remote pick-up receivers and the local receiver.
- Key-type tone signal calling and push-to-talk switches.
- Hinged top cover allows easy inspection and servicing. Key lock provides security and protection.
- *New* good looking cabinet, heavy-gauge steel construction, rounded edges, and *new* high lustre blue-gray finish.

G-E radio engineers, located in principal cities, will assist you in your remote control and other radio problems. Call or write your local G-E office, or the *Electronics Department, Section 502B, General Electric Company, Syracuse 1, N. Y.*

GENERAL ELECTRIC

Everything for 2-way Radio

Co., Mr. Clement was associated with Canada Packers and Neon Products Ltd., both in Vancouver.

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G. S. Heylin Joins Staff Utilities Line Construction

Announcement has been made of the appointment of Gordon S. Heylin to the position of division manager of the Utilities Line Construction Co., Inc., in Pittsburgh, Pa.

G. S. Heylin

A graduate of the University of Illinois, class of 1928, Mr. Heylin spent the next seventeen years with the Detroit Edison Co. in various capacities. Starting with the stores department, he was later transferred to the employment department and then, entering the overhead lines department, he held various technical and supervisory positions, finally becoming assistant to the superintendent with responsibility for construction, maintenance, and operation work and the various construction and engineering personnel necessary for its execution.

Mr. Heylin joined Utilities Line Construction Co. last year.

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▶ WILLIAM A. WHITTLESEY III has been appointed assistant manager of the western division. Western Massachusetts Electric Co., with headquarters at Pittsfield, succeeding Jarius F. Burt, who has been holding this position temporarily in addition to being general sales manager of the system. Mr. Whittlesey has been with the company about 10 years, lately in the sales department. Mr. Burt continues as general sales manager.

▶ JAMES M. BLACKLIDGE, sales manager of the industrial division of the Standard Transformer Corp., Chicago, has been promoted to general manager of the division.

New Appointments Made by General Electric

Several new appointments have recently been made by the General Electric Co.

L. E. HILDEBRAND has been appointed assistant designing engineer of the motor engineering division, River Works at Lynn, Mass. Mr. Hildebrand has been with the company at Pittsfield and Lynn since 1913.

J. M. LANG has been apointed manager of the tube division of the electronics department with headquarters in Schenectady. He succeeds George W. Nevin, resigned. Mr. Lang was formerly manager of the Ken-Rad division of the department with headquarters at Owensboro, Ky. L. K. Alexander has succeeded Mr. Lang in Owensboro. Mr. Alexander has been identified with the company since 1933.

WALTER C. KIRK has been appointed designing engineer of the Ken-Rad division, electronics department, with headquarters at Owensboro, Ky.

E. H. FRITSCHEL has been named manager of sales of the tube division of the electronics department, with headquarters in Schenectady. He formerly was sales manager of transmitting tubes.

R. C. LONGFELLOW has been named engineer of the specialty division, electronics department. In this capacity he will be in charge of all engineering activities for the division, with headquarters in Syracuse, N. Y. He was formerly section leader of a radar engineering group of the transmitter division at Schenectady.

NAT GADA has been appointed sales manager of emergency communication equipment in the company's transmitter division of the electronics department with headquarters in Syracuse.

WILLIAM H. C. LEHMAN, for the past five years a member of the apparatus agency division of General Electric's industrial divisions, Schenectady, has been appointed asistant manager of apparatus sales of the General Electric Supply Corp., Bridgeport, Conn.

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▶ F. J. HOENIGMANN has been elected executive vice-president and a director of Florence Stove Co., Gardner, Mass. Mr. Hoenigmann was formerly with Cribben Sexton Co. He is chairman of the gas range division of the American Gas Association.

▶ W. A. FINN has been appointed export manager of Worthington Pump & Machinery Corp., following his release from the U. S. Navy. Mr. Finn succeeds GEORGE GELLHORN, who has become general manager of C. E. Halaby, one of Worthington's industrial machinery dealers in Colombia, South America. Before the war, Mr. Finn was manager of Worthington's Boston District office. His new headquarters will be in Harrison, N. J.

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Sinclair Refining Assigns New Duties to Zumbrook

Appointment of Paul W. Zumbrook as manager of domestic lubricating oil sales of Sinclair Refining Co. has been announced. In his new assignment, Mr. Zumbrook will coordinate the service and distribution activity of the Sinclair auto-

P. W. Zumbrook

motive and industrial lubrication staffs, working closely with equipment manufacturers for the development of lubricating oils. His offices will be in the company headquarters at 630 Fifth Avenue, New York, N. Y.

Mr. Zumbrook became associated with the Sinclair Refining Co. at the time of the establishment of the Chicago office in 1916. He has served on various industry committees since the NRA program. Mr. Zumbrook is a member of the lubrication committee of the American Petroleum Institute.

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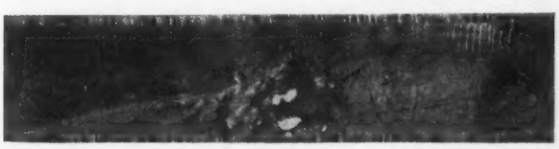
▶ M. L. PARKIN, who for the past 17 years has been associated with the Missouri Power & Light Co. in all phases of utility work, recently joined the A. B. Chance Co. to handle one of their Tips Tool demonstration and display units.

▶ CHARLES WEBBER has been appointed managing director of The Bristol Co. of Canada, Ltd. Mr. Webber will be in complete charge of the Canadian factory, which is located in Toronto. He brings to his new position more than 25 years of experience in instrument manufacture and sales. He was formerly New York

HOW THE ANODIC POINTS WERE CAPTURED

In many cases where a condenser tube has proven unsatisfactory in a given application, analysis of conditions will show the cause of the failure to be outside the tube itself.

A Scovill engineer was requested to explain the puzzle of the consistent failure of tubes in the first pass of a marine condenser. 18 tubes had failed in this pass, as the result of intense local pitting.

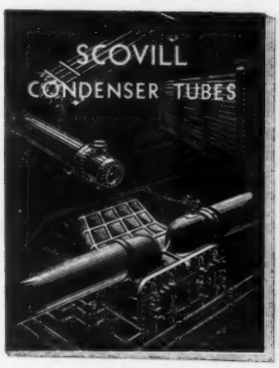


Deposits Had Done It — He found that the pitting was due to "deposit attack", an electrochemical type of corrosion initiated by foreign material lodged against the tube walls. Where such deposits covered the metal, those "islands" became anodic to the adjacent uncovered areas, with resultant intense corrosion of the anodic area. In this case, turbulence of the water passing around the deposit caused erosion-corrosion on downstream side of deposit.

Examination showed no evidence of any other type of corrosion.

The suggestion of the Scovill engineer which aided in the solution of the problem was to modify the circulating water inlet and to establish a regular practice of cleaning the tubes, using rubber plugs, bristle brushes or other equipment that would not score the tube walls.

Three Scovill Services — Scovill *Service in Men* provides specialized study and advice on individual tube application problems and on installation practices. *Service in Metals* includes production of many tube alloys, and also offers you the facilities of our laboratory to help determine the alloy best suited to your conditions. *Service in Manuals* provides valuable literature on condenser and heat exchanger tubes; for a free copy of our Condenser Tube Booklet, address Scovill Manufacturing Company, 24 Mill St., Waterbury 91, Conn.



ONE PRODUCT
THREE SERVICES
Service in Manuals
Service in Metals
Service in Men

SCOVILL

Scovill
CONDENSER TUBES

You can cut and fit TRANCELL . . . to suit your space and requirements

Unusually Workable, this strong, asbestos-and-cement housing comes in large sheets that can be cut, drilled and bolted right on the job . . . is rotproof and rustproof, requires no painting . . . and little, if any, upkeep.

Dry-Constructed. Trancell housings are erected without water . . . make a neater and faster job. Non-metallic, Trancell reduces the danger of shorts due to condensation. Its low conductivity protects adjacent equipment against heat transmission. Fireproof, it confines oil fires to the cells in which they originate.

Lightweight, Trancell doesn't overload balconies and upper floors. Barriers and shelves of this material, though strong, are unusually light in weight. Excellent for alterations, it can be built around your present equipment quickly and economically. A complete line of hardware for Trancell doors is available.

Johns-Manville supplies Trancell cut to special dimensions, or, if you prefer, you may cut it in your own plant as most maintenance departments do . . . saving shut-down time, numerous detail drawings and materials. For full details, write Johns-Manville, Box 290, New York 16, N. Y.

Johns-Manville TRANCELL
an asbestos product . . . for housing electrical equipment

district manager of The Bristol Co. and prior to that was associated with the company at Waterbury, Conn.

► CLARENCE L. HANCOCK has been promoted to manager of the technical service department of the Bridgeport Brass Co., Bridgeport, Conn. Mr. Hancock has been identified with the company continuously for 25 years and previously was located in the company's New York office, where he was sales manager of Phono-Electric trolley wire and condenser tubing.

► FRED C. WALTER, who has been associated with the sales, advertising and product development department of the Formica Insulation Co., Cincinnati, for 17 years, has been promoted to be assistant sales manager of the company.

► M. B. SQUIRES has been appointed manager of sales for all domestic and foreign distribution of the conduit products of Spang-Chalfant, Pittsburgh. Mr. Squires was formerly connected with the Central Tube Co., which was purchased by Spang-Chalfant in 1940.

► RUSSELL E. KRAFT has joined Radio Frequency Laboratories, Inc., Boonton, N. J., as senior electrical engineer. Mr. Kraft goes to RFL from the Navy, from which he has just been discharged with the rank of lieutenant commander after five years service. Before the war, Mr. Kraft was a communications engineer with the A. T. & T.

► FRANK A. BALLMAN has been appointed general sales manager of Thermador Electrical Manufacturing Co., Los Angeles. Mr. Ballman was well known in retail and wholesale home appliance merchandising before joining the AAF.

► PAUL D. CORNELISEN has returned to Curtis Lighting, Inc., after having served in the United States Navy for more than three years, where he attained the rank of commander. He is now carrying on his new duties as general sales manager. Starting at Curtis Lighting in 1921, he first worked in the engineering department and later served in Indianapolis and St. Louis. In 1927 he became Chicago sales manager. In 1936 he moved to the Detroit office, remaining there until he entered the Navy in 1942. He reports to G. T. Morrow, vice-president in charge of sales.

► T. P. JAMES and H. S. PERKINS have been appointed assistant general sales managers of the Proctor Electric Co., Philadelphia. Mr. James' responsibilities will cover the direction of sales activities for major accounts including syndicate buying groups, chain stores, furniture stores, jewelry stores and other

large volume outlets. Mr. Perkins will be responsible for the general dealer distribution of Proctor products.

▶ HENRY C. L. JOHNSON has returned to Sylvania Electric Products Inc. after three years of service in the United States Navy. He will resume his position as advertising manager of the radio division, and in addition, he will direct the advertising and sales promotion of the industrial electronics and international divisions.

▶ NORWOOD D. CRAIGHEAD has been appointed assistant sales manager of Bendix Home Appliances, Inc. Mr. Craighead will continue to serve as retail merchandising manager and director of sales training until his successor is appointed.

▶ A. J. KERR, formerly general sales manager, has been elected vice-president of sales of the Rockwell Manufacturing Co., Pittsburgh. Mr. Kerr has been associated with the company for more than 20 years. His early career was as district manager, Tulsa office of the Pittsburgh Equitable Meter and Nordstrom Valve Companies, now divisions of the Rockwell Manufacturing Co. In 1944 he was made general sales manager.

▶ K. U. WIRTZ, formerly assistant secretary of the Electric Furnace Co., Salem, Ohio, has been appointed executive vice-president. C. L. WEST, vice-president, has been placed in charge of sales and C. H. VAUGHAN, who has served in various capacities, has been made assistant vice-president.

OBITUARY

▶ PROF. CHARLES FABRY, director-general of the Vision Institute of the French Committee of the International Commission on Illumination, died recently in Paris. He was 78 years of age. Formerly professor at the Sorbonne and Polytechnic School, Mr. Fabry was appointed vice-president of the I.C.I. in 1922 and by unanimous vote of those present at the Berlin meeting in 1935 he was elected to the presidency.

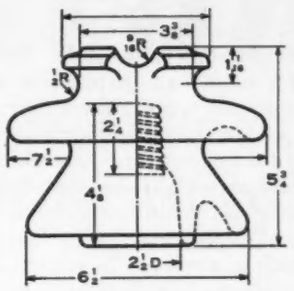
▶ HERBERT H. EVANS, a production engineer with the W. L. Maxson Corp., electrochemical engineers, New York, died on March 17 at the Orange Memorial Hospital, South Orange, N. J. He was a graduate of Swarthmore College and a member of the American Society of Mechanical Engineers.

▶ MORRIS S. HAWKINS, who was prominently connected with the old Princess Anne Power Co., Norfolk, Va., died suddenly on March 14 in that city at the age of 64. Mr. Hawkins was a native of Norfolk.

THOMAS
PIN TYPE INSULATORS

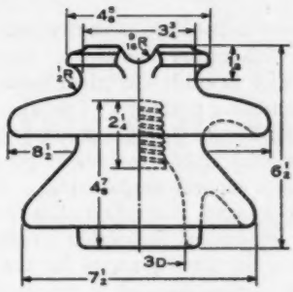
Here are a few transmission line Pin Types selected from our complete line of Porcelain Insulators by Engineers for their dependability and record for long time service.
For complete engineering details and a copy of our latest Catalog No. 40—mail the coupon below.

TYPICAL DESIGNS



NO. 1917-M
27 Kv. Rating

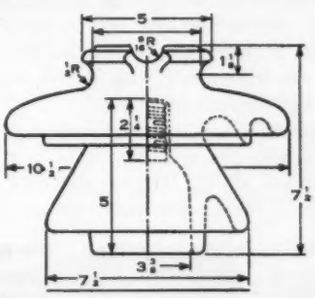
Dry Flashover	95 Kv.
Wet Flashover	65 Kv.
Rec. Pin Height	7 in.
Std. Pkg. Bbl.	25



NO. 1925-M
35 Kv. Rating

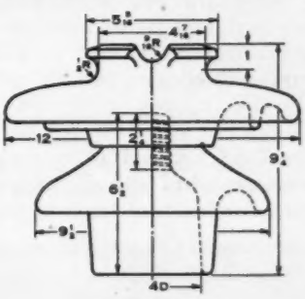
Dry Flashover	110 Kv.
Wet Flashover	75 Kv.
Rec. Pin Height	8 in.
Std. Pkg. Crate	8

All Thomas Pin Type Insulators can be furnished in "Quiet-Type" insulators for the positive elimination of insulator radio interference. To order "Quiet-Types" simply specify "Q-T" after catalog number.



NO. 1924-M
45 Kv. Rating

Dry Flashover	125 Kv.
Wet Flashover	85 Kv.
Rec. Pin Height	9 in.
Std. Pkg. Crate	6



NO. 2126-M
55 Kv. Rating

Dry Flashover	145 Kv.
Wet Flashover	100 Kv.
Rec. Pin Height	10 in.
Std. Pkg. Crate	3

The above one-piece designs can also be furnished in two-part designs when preferred. Both designs are very rugged, well balanced, and proved by years of continuous line service.

THE R. THOMAS & SONS CO.
Lisbon, Ohio

Please send me your Catalog No. 40 illustrating Porcelain Insulators and Line Hardware for Distribution Lines.

Name ---------- Title ----------

Address ----------

City and State ----------

THE R. THOMAS & SONS CO.
LISBON, OHIO
New York - Boston - Chicago

MANUFACTURING MARKETS

New Connector Lab at Thomas & Betts

Thomas & Betts Co. recently dedicated a new laboratory which is equipped specifically to study electrical connectors and connecting problems. The laboratory has facilities to further the company's experimental and development program, to further general engineering and production quality control studies and to further studies of inspection techniques. At the same time, quarters for the engineering section devoted to research and development were enlarged.

Among the new pieces of equipment are a test board for making tests on electrical connections or joints carrying up to 1,500 amp., an electric oven to assist in studying metals under various heat conditions, a dark room for photomicrograph equipment, a vibration tester, three tensile testing machines, a Rockwell tester and a hydraulic press.

The test board was designed by the company engineers for studying all types of electrical connectors used on solid or multi-strand conductors carying currents from 10 milliamperes up to 1,500 amp. This equipment was built by Standard Electric Time Co. and is in reality a double section board with alternating current for extended heat runs on the left and direct current for millivolt drop and resistance testing on the right. The board includes a 2,000 a.c. amp. meter, a 1,500 d.c. amp. meter, an interval timer, a 10-point selector switch for the thermocouple circuits, a Powerstat for controlling voltage, and a specially designed, J.B.T. Instrument Co. built, potentiometer-pyrometer. Voltage readings as low as one millionth of a volt can be made, useful in determining voltage drop through connections. The board has sufficient battery capacity to maintain a full load of 1,500 amp. plus a suitable battery charger.

Electric oven is of the forced air circulating type, has automatic timing and temperature control features for working temperatures up to 260 deg. C. The vibration tester is of the variable amplitude and frequency type and has variable control between 10 and 60 cycles per second. The three tension testing machines have capacities of 2,500 lb. and 10,000 lb. and 30.000 lb. Enlargements up to 400 diameters are obtainable with the photomicrographic equipment.

Experimental and development work in the laboratory will be under the supervision of M. D. Bergan, director of research; the general engineering studies and production quality control tests will be supervised by C. A. Badeau, chief engineer, and inspection technique studies will be under the jurisdiction of D. Potter, chief inspector.

•

Condenser Production Cost Cut 20 Percent

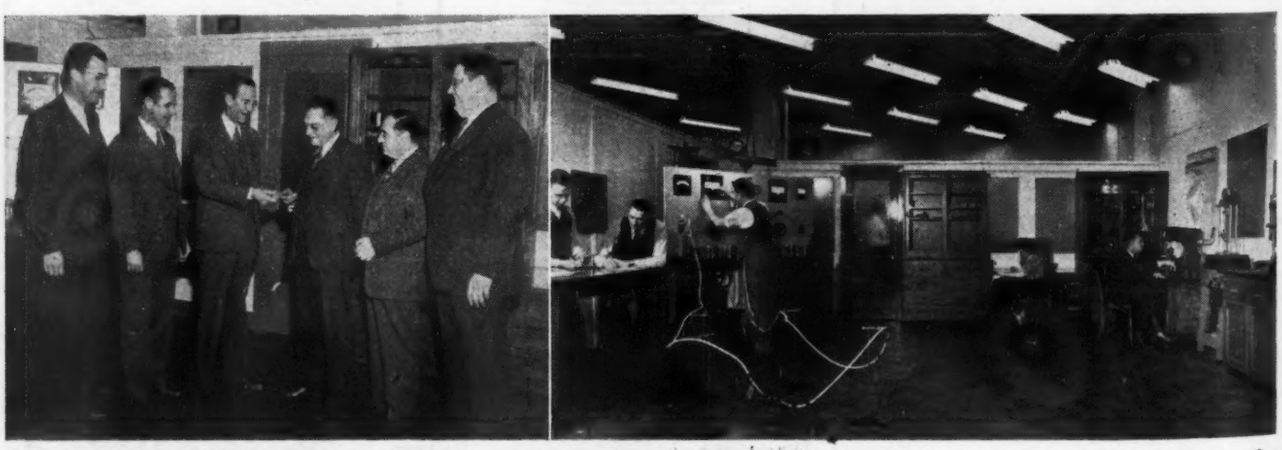
Reduction of 20 percent in the manufacturing costs of condensers for electronic equipment was reported possible by a Robert Bosch Co., Stuttgart, Germany, development which the Department of Commerce is bringing to this country.

The machine is stated to turn out paper condensers in which the usual metal foil is replaced by "a very thin, vaporized zinc coating applied directly." It is now en route to this country and will be made available for inspection by American manufacturers upon arrival.

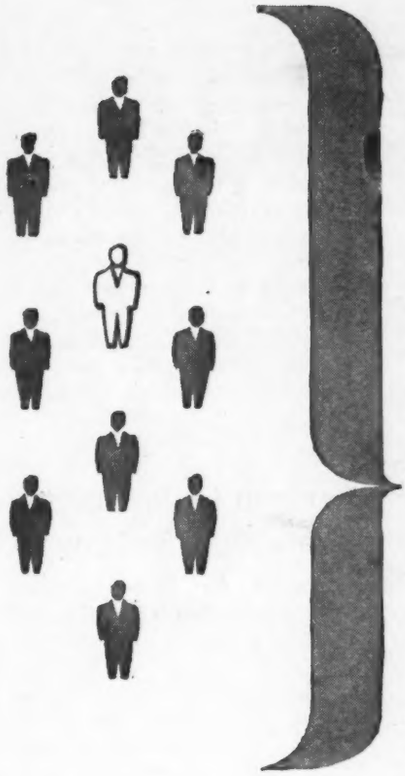
A second new technique developed in Germany during the war involved the rolling together of aluminum foil and 0.01 millimeter thickness of "styroflex," a new German plastic, believed to consist of polyvinyl benzol.

The condensers varied in capacity and were 1½ centimeters in diameter and 6-7 centimeters in length. Each condenser was housed in a cardboard tube, and the connections were brought out from each end of the cylinder.

The "styroflex" used in the condensers is a clear, transparent, flexible plastic, originally developed by the Germans for use as an insulating material between the core and the shield of coaxial submarine cables. It is made from an I. G. Farbenindustrie product, "Polystrol," a coarse, granular substance. The "Polystrol" is poured into machines which melt and



KEY TO RESEARCH AND STUDY—G. C. Thomas, chairman of board of Thomas & Betts Co., handed D. Potter, chief inspector, the key to the company's new laboratory and at this time expressed the thought that as the key unlocks the laboratory so must the laboratory unlock the secrets of connections. Looking on are other company officials—at left of the participants, C. A. Badeau, chief engineer, and M. D. Bergan, director of research; on the right are N. J. MacDonald, vice-president, and J. B. Clapp, manager of utility division. Two hours later, in the illustration at the right, heat runs were being made on three compression splices on a No. 4/0 aluminum conductor. At the extreme right the effect of heat on the alloy used in a test specimen is being studied



9 OUT OF 10 *want* THE PAYROLL SAVINGS PLAN CONTINUED!

Thanks to the cooperation and encouragement of America's industrial executives, 85 million bond holders have bought U.S. Bonds in the greatest savings program in history. Employees who have purchased billions of dollars of these bonds during the war now want to continue monthly purchases of savings bonds. Specific evidence of this desire to continue saving for personal security and prosperity through the Payroll Savings Plan was recently revealed by a survey which disclosed that 90% wanted the Plan continued.

Every employer can write in his own set of reasons why the Payroll Savings Plan should be continued as a part of his personnel relations program, but the principal advantages are obvious:

A large reservoir of national savings; a strong and stable bulwark against inflation.

An "automatic" thrift habit for the worker; to increase contentment and satisfaction in his job.

An opportunity for the employee to maintain his "share in America" with the safest, easiest, most profitable investment he can make.

An opportunity for the returned veteran to share in the Payroll Plan's varied benefits.

Your employees will require little "selling" on the idea—they are accustomed to their monthly saving habit. With the Treasury Department's savings bond program now in peacetime operation, your partnership is again invited to continue this systematic, convenient means of contribution to a prosperous peacetime future.

The Treasury Department acknowledges with appreciation the publication of this message by

ELECTRICAL WORLD

This is an official U. S. Treasury advertisement prepared under the auspices of the Treasury Department and Advertising Council

mix it and then extrude it in the form of a band about ¼ inch thick and 1¾ inches wide. This band is said to be tougher than glass, but it can be shattered by a sharp blow.

To produce "Styroflex," the bands of "Polystrol" are remelted and extruded. "Styroflex" comes from the die in tubular form. The continuous tube is drawn out and flattened by machine and then cut at the bends so as to form two flat sheets, which are then trimmed, cut into strips, and wound on spools.

•

Noma Absorbs Assets of Subsidiary Units

Reduction of 100,000 shares in the outstanding capital stock of Noma Electric Corp. will result from a decision by its directors to consolidate the assets of its wholly owned subsidiary, the Ansonia Electrical Co., into Noma, Henri Sadacca, Noma's president, has announced. The consolidation will become effective as of March 31.

Ansonia Electrical Co. now holds in its treasury 100,000 shares of Noma Electric Corp. stock. With the consolidation it is planned to cancel these 100,000 shares, Mr. Sadacca said, leaving outstanding approximately 514,000 shares of Noma capital stock.

Management and operation of Ansonia will continue unchanged under the direction of William J. Weaver, president of the company, except that the entire business will be continued as a division of Noma, Mr. Sadacca stated.

Mr. Sadacca also announced that as of March 31 the assets of Air Conditioners Sales Corp., another wholly owned subsidiary, will likewise be consolidated into Noma, and its operations conducted as a division under the management of Albert C. Muller, Jr., president of the company.

In the near future, another wholly owned Noma subsidiary, Glolite Corp., will be consolidated into Noma and its operations conducted as a division under the direction of G. R. Simon, president. Glolite products include novelty lighting decorations.

In all three instances, the charters and corporate names of the subsidiaries will remain in existence, but all assets and operations are to be absorbed into Noma.

•

Merger Program Approved

Directors of Raytheon Manufacturing Co. and Submarine Signal Co. unanimously approved combination of the two companies, through the exchange of five shares of Raytheon for one share of Submarine Signal.

Strikes May Shut Off All Copper Supplies

More difficulties on the labor front threaten to shut off almost the entire domestic supply of copper and a large part of the zinc.

Latest development is the notification received by Anaconda Copper Mining Co. from union representatives that all operations at Butte, Anaconda and Great Falls, Mont., will cease at 7 a.m. March 31. This action was taken by joint negotiation committee of the unions representing the miners and smeltermen at these properties. The company's copper refinery at Raritan, N. J., already is closed by a strike, and if the strike at the Montana plants is called it will leave only one electrolytic copper refinery in operation, the Carteret, N. J., property of the American Metal Co., Ltd.

Labor difficulties have closed all copper and lead plants of the American Smelting & Refining Co. Wage demands have resulted in the shutdown of Kennecott Copper Corp.'s Utah mine and properties of the U. S. Smelting, Refining & Mining Co. in Utah are closed down. Also shut are refineries and mines of Phelps Dodge Corp., although last week Phelps Dodge Copper Products Corp., whose local plant at Elizabeth, N. J., has been idle for three months, announced the ratification of a new two-year contract, which provides a wage increase of 18½ cents an hour, between the company and Local 700 of the International Union of Mine, Mill and Smelter Workers, CIO.

About 3,000 employees at the plants of the Electric Storage Battery Co. went on strike last week for a wage increase of 13½ cents an hour and additional paid holidays. Joseph Kelly, president of Local 113, United Electrical, Radio and Machine Workers, CIO, said that the employees walked out when the company refused to give a definite answer on the wage increase. The company issued a statement in which it said that the matter of wages "was disposed of by an increase of 5 cents granted last December and the acceptance by the company of the union's proposal of 13½ cents at this time."

•

Demand for Products Hits New High, Ballantyne Says

Demand for Philco products was never greater than it is today, and orders on hand insure capacity operations for at least the rest of this year, John Ballantyne, president, has told stockholders.

"Due to conditions beyond the control of the management, of this or any other single company, our production remains at an unsatisfactory level and is much lower than our schedules called for," Mr. Ballantyne said.

•

Eureka Changes Name

Stockholders of the Eureka Vacuum Cleaner Co. have approved the proposed change of the company's name to Eureka Williams Corp. Production of new products is being accelerated at the company's plants in Detroit and Bloomington, Ill.,

FARM AND WATER—Ten farm service representatives of the New York State Electric & Gas Co. recently attended an all-day session at Goulds Pumps, Inc., Seneca Falls, N. Y., studying water systems and their application to the farm. The meeting was a cooperative venture on the part of the manufacturer and the utility in the better utilization of power on the farmstead. Subjects such as types of pumps used for water supply, selection and application of proper units, installation methods, and how to avoid trouble were discussed by John B. Darden, George W. Cramer and L. H. Hammond of Goulds Pumps

ANSONIA BUILT A GREAT NEW FLEXIBLE CABLE FOR NAVY RADAR

For use on radar and gunfire control, the Navy needed a specialized high frequency cable. It had to feature:

(1) flexibility
(2) extreme low dielectric loss factors
(3) serviceability under extreme weather conditions.

WANTED—High Frequency Transmission Problems, for M-I-29 . . . a new flexible cable featuring extremely low loss and high conductance. For use where coaxial characteristics are required in a flexible cable.

In cooperation with Navy Engineering, Ansonia helped develop a cable answering these requirements—M-I-29—available now, to you!

To the Navy this cable represented high fidelity radar images and dependable service under severe operating conditions. To you, it may mean clearer television, truer FM radio tone or the solution of a problem in transmitting ultra high frequency power with low loss, since it approaches coaxial cable in dielectric qualities yet is completely flexible.

Insulated with ANKOSEAL thermoplastic insulation, M-I-29 can be engineered and supplied to meet special dielectric characteristics and operating conditions. "Yankee Ingenuity" displayed in the creation of this cable is ready now to help make it meet your particular needs.

This is one of a complete line of *job-engineered* cables made by Ansonia. For details on this or other cables, write Dept. AL The Ansonia Electrical Company, Ansonia, Conn.

Why ANKOSEAL *solves cable problems*

Ankoseal, a thermoplastic insulation, can help solve many electrical engineering problems, now and in the future. *Polyvinyl* Ankoseal possesses notable flame-retarding and oil resisting characteristics; is highly resistant to acids, alkalies, sunlight, moisture, and most solvents. Polyethylene Ankoseal is outstanding for its low dielectric loss in high-frequency transmission. Both have many uses, particularly in the radio and audio fields. Ankoseal cables are the result of extensive laboratory research at Ansonia—the same laboratories apply engineering technique in the solution of cable problems of all types.

THE ANSONIA ELECTRICAL COMPANY

Specializing in "Ankoseal" a Thermoplastic Insulation

ANSONIA CONNECTICUT

A Wholly-Owned Subsidiary of

NOMA ELECTRIC CORPORATION

GENERAL OFFICES • NEW YORK, N. Y.

Makers of the famous Noma Lights—the greatest name in decorative lighting. Manufacturers of fixed mica dielectric capacitors and other radio, radar and electronic equipment.

and output will soon surpass the pre-war rate, assuming an adequate flow of materials, H. W. Burritt, president, stated.

•

CPA States 90,000 Tons Tin Available in '46

About 90,000 tons of tin will be available to American industry in 1946, according to a recent Civilian Production Administration report. To do this, about 65,000 tons of virgin tin will be made available, an increase of 7,000 tons over 1945. Secondary tin recovery is expected to approximate 26,000 tons, which brings the total available to 91,000 tons.

To supply the 65,000 tons of virgin tin will necessitate drawing on government stocks to the extent of about 23,000 tons, the report continues. Approximately 42,000 tons is expected to be imported and this is made up of 12,000 tons of pig tin and 30,000 tons of concentrate. Government owned stocks are expected to be down to 15,000 tons at the end of 1946.

Despite this poor outlook, the administration plans to supply the vitally needed tin for solder and other pressing essentials, the report indicates.

•

Anaconda Wire Receives Naval Ordnance Award

Anaconda Wire & Cable Co. has been given the Naval Ordnance Award, according to H. Donn Keresey, president of the company. The award was based on development of a "top drawer" secret device used in connection with magnetic underwater ordnance. Details concerning the developments are still a closely guarded secret and the only descriptive matter so far released says that the device was "one of the most delicately sensitive (devices) to come out of the war."

The citation to the company by Rear Admiral G. F. Hussey, Jr., says the award is being made for "exceptional service to Naval ordnance research and development." During the war the company received more than twenty Army-Navy "E" awards.

Motion Study Film Digest Completed

The 250,000 ft. of film showing the application of the principles of motion study taken by Frank B. Gilbreth between the year 1905 and 1924 have been reviewed and a resulting movie digest prepared under the sponsorship of the Chicago Chapter of the Society for the Advancement of Management.

Dr. Ralph M. Barnes, professor of industrial engineering and director of personnel at State University of Iowa, Dr. Lillian M. Gilbreth, management consultant, Montclair, N. J., and James S. Perkins, chief of personnel development, Hawthorne Works, Western Electric Co., Chicago, collaborated in making the digest.

Some of the more significant studies which the film includes are (1) The brick laying project which led to motion study, (2) Factory operations which led to the development of motion study principles, (3) The first methods studies of surgical operations, (4) Frederick Taylor's pig iron carry experiment, and (5) A study of skill by the cyclegraph technique. It is a 1,200 ft., 16 mm., silent film which was made primarily for universities, business and industrial organizations. The film can be purchased from the Society for the Advancement of Management, 426 S. Maple Ave., Oak Park, Ill.

•

New Electromaster Plant Takes Shape

Construction work on the center section of the new Electromaster, Inc., plant is progressing satisfactorily, according to the announcement of R. B. Marshall, Electromaster president. Steel girders are in place and the building is now ready for the roof and siding.

When completed this section will have 75,000 sq. ft. of space and will house the porcelain enameling, finishing, and assembly operation. The company expects to occupy the new building in April.

Marshall points out, however, that the general offices, press division, water heater and commercial departments will remain in their present Detroit location until the second section of the building is completed. This partial-moving plan is necessitated to insure uninterrupted production to handle the greater sales volume of electric ranges and water heaters resulting since the inauguration by the company of the new national sales distribution program through 70 distributors and 6,000 dealers.

MORE ROOM—Construction adds 75,000 sq.ft. of space in the first portion of a two part construction program. The increased room is needed to accommodate greater range and water heater production

•

Electric Equipment Concern Organized by L. R. Lewis

Formation of the Lewis Electrical Equipment Co., specializing in the sale of electrical equipment to utilities, railroads and industrial concerns, was announced recently by L. R. Lewis.

L. R. Lewis

The establishment of the new organization follows Mr. Lewis' retirement from the manufacturing business, after serving as president and, more recently, chairman of the board of Electrical Power Equipment Corp., Philadelphia.

Officers of the new sales company will be located at 560 North 16th St., Philadelphia, and will serve eastern Pennsylvania, southern New Jersey and Delaware.

•

Atomic Energy Classes Started by Allis-Chalmers

To enable its personnel to become broadly informed on the very timely subject of atomic energy, the Allis-Chalmers Mfg. Co., Milwaukee, Wis., in cooperation with the Illinois Institute of Technology, is offering a special graduate course, believed to be the first of its kind by any industrial firm in the nation, on the introduction to atomistics and applied nuclear physics.

The 16-week course, which started March 8, presents a series of guest lec-

turers including such eminent physicists as Dr. Don Kerst, who contributed materially to development of the betatron, and Dr. G. M. Almy, professor of physics at the University of Illinois, and other leading physicists of the University of Chicago and the University of Wisconsin. Lectures are given from 6:00 to 8:00 p.m., one night a week.

•

Manufacturers Make Sales Assignments

Electrical manufacturing companies have recently announced the following appointments to their sales staffs:

WESTINGHOUSE ELECTRIC CORP. has appointed Leslie E. Lynde New England district manager, succeeding Frank L. Nason, who has held that position since 1938 and who now becomes a special representative of the corporation in that district. Mr. Lynde has been with Westinghouse since 1920.

SANGAMO ELECTRIC CO. announced the appointment of Robert H. Fleming as district manager of the southeast territory with headquarters in Atlanta, Ga. Mr. Fleming was assigned to the Navy Electronics Division, Bureau of Ship, Washington, D. C., and was separated in December, 1945.

HOMELITE CORP., Port Chester, N. Y., has opened a new branch office in the Terminal Sales Building, Seattle, Wash. A. D. Sherwood will be in charge. Before entering military service, Mr. Sherwood was with Homelite.

ALLEN-BRADLEY CO., Milwaukee, has appointed Campbell & George Co., 379 Brannon St., San Francisco 7, Calif., to handle its line of electric controls in northern California.

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Sylvania Tubes will Be Made in Great Britain

Sylvania type radio tubes will be manufactured in Great Britain in large quantities by a newly formed company, Electronic Valves, Ltd., according to an announcement by Walter E. Poor, president of Sylvania Electric Products Inc. and T. A. Macaulay, chairman of A. C. Cossor Ltd., of London. Paid-in capital will be £300,000. Operations are scheduled to begin April 1.

•

Adds Motors to Line

Automatic Control Engineers, Inc., Bedford, Ind., have entered the fractional horsepower motor field and are manufacturing standard types of split-phase and capacitor-start motors. In addition, the company is continuing the manufacture of voltage regulators, synchronizers, frequency control, and special control apparatus.

Long-Span Construction Cuts Rural Line Costs

Savings of $100 to $120 per mile have been reported where *Crapo* Steel Conductors have been used in long-span rural distribution lines. These savings will be an important consideration in the rural power expansion program which lies ahead.

Crapo Steel Conductors are especially applicable to the tap and branch lines which make up a substantial part of the rural mileage yet to be built. These ferrous conductors, with their relatively low 60-cycle resistance and reactance, will carry the voltages and loads ordinarily imposed on typical rural extensions with a voltage drop well within prescribed limits.

I^2R losses on rural lines built of *Crapo* Steel Conductors are so small as to be negligible especially when compared with the potential overall savings. The high rugged strength of these conductors makes possible extra long spans, reduces the number of pole structures per mile, cuts material and labor costs, minimizes maintenance.

Complete Technical Information

Investigate the practical economy of *Crapo* Steel Conductors for your post-war rural program! Ask a representative of Graybar Electric Company, Inc., Distributor, or write direct for a copy of our Engineering Manual!

INDIANA STEEL & WIRE COMPANY
MUNCIE, INDIANA

Crapo HTC-130 STEEL CONDUCTORS

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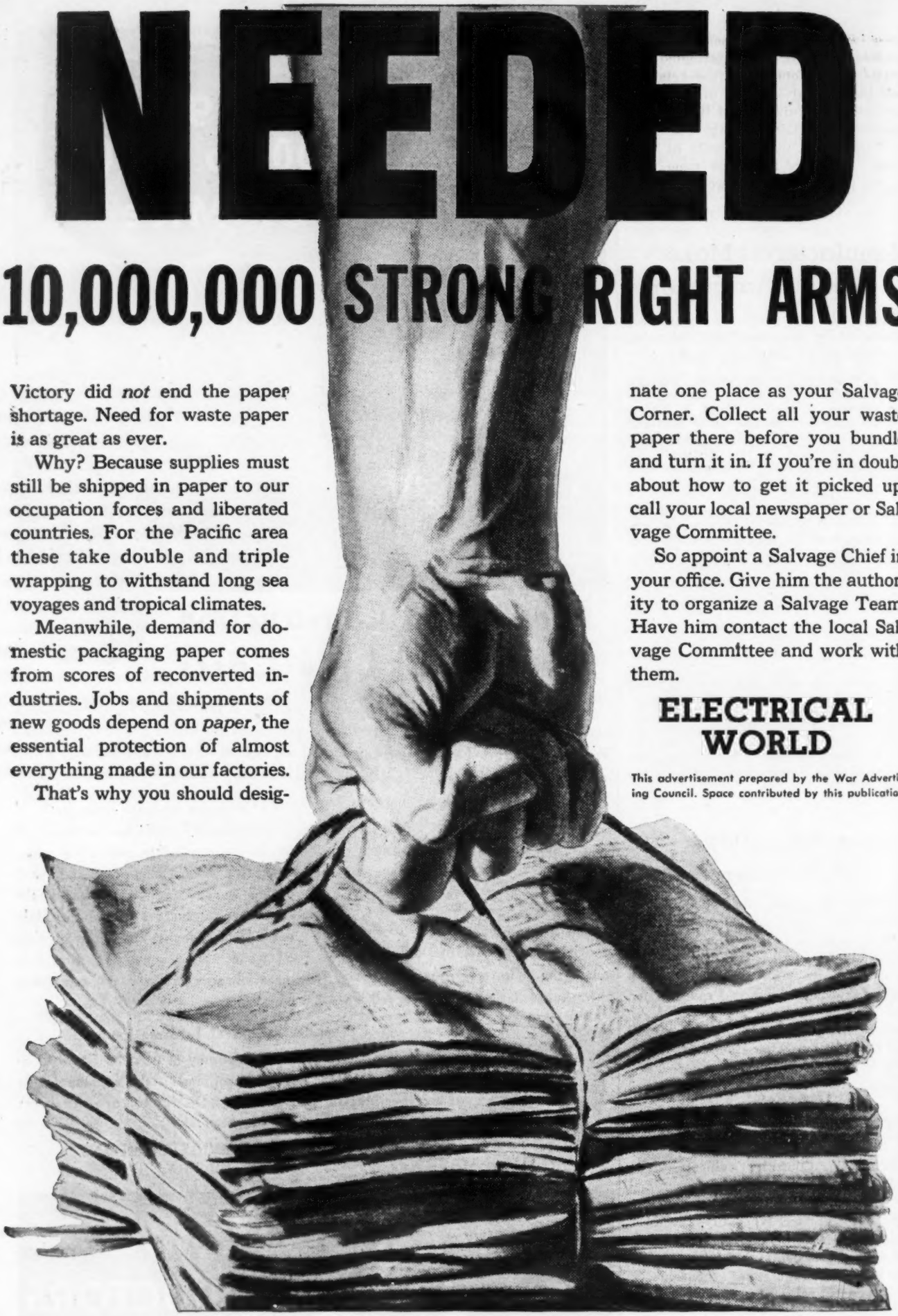
10,000,000 STRONG RIGHT ARMS



Victory did *not* end the paper shortage. Need for waste paper is as great as ever.

Why? Because supplies must still be shipped in paper to our occupation forces and liberated countries. For the Pacific area these take double and triple wrapping to withstand long sea voyages and tropical climates.

Meanwhile, demand for domestic packaging paper comes from scores of reconverted industries. Jobs and shipments of new goods depend on *paper*, the essential protection of almost everything made in our factories.

That's why you should designate one place as your Salvage Corner. Collect all your waste paper there before you bundle and turn it in. If you're in doubt about how to get it picked up, call your local newspaper or Salvage Committee.

So appoint a Salvage Chief in your office. Give him the authority to organize a Salvage Team. Have him contact the local Salvage Committee and work with them.

ELECTRICAL WORLD

This advertisement prepared by the War Advertising Council. Space contributed by this publication.

Field Reports on Business

Shortages of materials essential for the production of electrical equipment is tying up deliveries, but reports indicate that record breaking backlogs of orders are on hand. There is considerable activity in the lighting and air conditioning fields. Appliances are available in limited numbers.

NEW YORK

Equipment deliveries to date have not been materially affected by the termination of several strikes in the electrical industry. The two factors most often heard in discussing this in the New York area are insufficient time lapse between the settlement of the strikes and the inability of manufacturers in obtaining certain materials and components parts.

Very little heavy equipment movement was noted during the week. However, one utility in this trading area received notice that a large generating unit, which was in the process of assembly when the major electrical companies went out on strike, will be one of the first units shipped.

Appliances are arriving, but at a very slow rate. Most distributors are telling the retailers that six to eight weeks will elapse before these will arrive in any volume and that the volume at that time will be far behind the demand.

Distributors are advising the retailer to do a "good job servicing existing appliances," and use this as a technique of building up prospect lists. They are also assisting the outlets with planning for that day when appliances will be plentiful. Among the subjects receiving attention are hiring and training of salesmen, developing good display techniques and the proper coordination with utility promotion campaigns.

Activity is already starting in financing the sale of appliances. Representatives of the older commercial institutions who were in this field before the war are making efforts to get "set-up" before the competition from the banking field can get started.

NEW ENGLAND

Material shortages needed for the production of electrical equipment continue to tie up deliveries in this area. Manufacturers of insulated wire and cable, electrodes, and power equipment are particularly hard pressed. On the other side of the picture, reports received from many companies point to record breaking backlogs of orders on hand. Both engineering and architects' offices have an enormous amount of planning on hand. Preliminary field construction has begun at Public Service of New Hampshire's 10,000 kw. hydro-electric development at Berlin. General Electric was awarded the generator contract and Baldwin Locomotive Works will build the waterwheel. Cost of development is about $1,700,000.

General Electric's plastic business is expected to double pre-war output. Silex Co., Hartford, Conn., has a backlog of orders equal to the best two years ever previously recorded by the company. Building activity is beginning to advance; Monsanto Chemical Co. is adding two factory-type buildings estimated at $100,000 in Springfield, Mass., and Albert Steiger Co., Springfield, Mass., will soon install escalators for 4th floor service in its store at a cost of approximately $180,000. The Somerset Hotel, Boston, has been modernized according to plans which called for new lighting involving an outlay of more than $100,000; in addition, all functional rooms of the hotel were air-conditioned and a 100-ton capacity air conditioning and ventilating plant were installed for that purpose. Rearrangement of the hotel for apartment units resulted in the purchase of 92 electric ranges and refrigerators. The main kitchen equipment for transient service has also been completely modernized by the installation of all-electric cooking appliances.

CHICAGO

Within the next three years Illinois Bell Telephone Co. plans to spend $160,000,000 for buildings, equipment, poles, cable and wire, the bulk of the money to be spent in Chicago and to be used for improving service through conversion to dial phones, the inauguration of automobile radio-telephony, and participation in a nationwide television network. Tests are to be conducted this year on private line radio-telephone communication on railroads.

Sonora Radio & Television Corp. predicts television will be a commercial reality within a year, and within the next five will revolutionize home entertainment, have a tremendous effect on consumer industries depending on eye-appeal for sales, and will provide a living for 2,500,000 persons engaged in producing, distributing and broadcasting television.

Estate Stove Co. has been acquired by Noma Electric Corp. Edison General Electric Appliance Co. has formed Hotpoint Institute, a home economics activity aimed at training retail sales personnel in the techniques of consumer education in the use of electric appliances.

Total value of building permits in the Chicago metropolitan region declined in February, in comparison with January, in proportion to the length of the month, thus indicating that building activity is just holding its own.

PACIFIC COAST

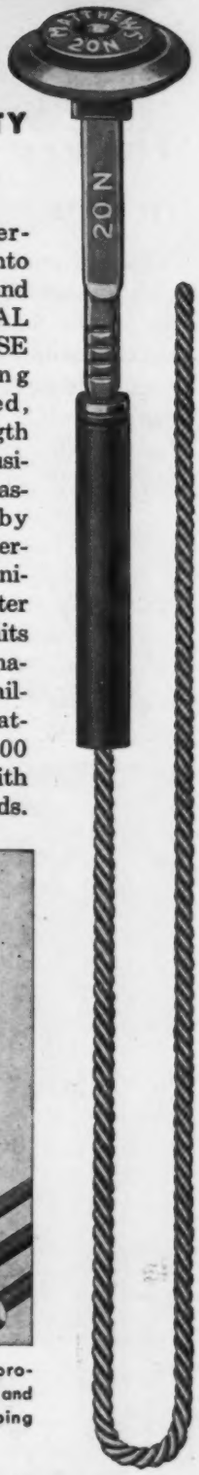
The total value of February building permits in the seven western states was $74,734,712 nearly six times the figure of February 1945 and a decrease of less than 10 percent from record breaking January. The interior states of Arizona, Idaho, Nevada and Utah all considerably increased over the general average. A steady advance in even these totals is expected curtailed, however, by shortage of materials of which electrical wiring material is now about the most drastic.

Recent destruction by fire of the Gardner plant in Oakland will intensify the already severe delivery conditions for smaller power apparatus along the coast because this plant specialized in transformers and unit substations.

A backlog of more than $200,000,000 of power system additions and betterments for 1946 has been accumulated along the Pacific Coast, of which nearly $150,000,000 has been contributed by privately owned companies.

The 1946 electrical appliance market for eleven western states has been conservatively estimated as exceeding $330,000,000. Delivery conditions from manufacturers justify strict allocations even among long-standing and well-established dealers, and manufacturers naturally believe that such deserve first consideration.

UNIVERSAL MATTHEWS FUSE LINKS



- ACCURACY
- UNIFORMITY
- STRENGTH

• These characteristics are designed into the SERIES 50H and 100H UNIVERSAL MATTHEWS FUSE LINKS by using closely calibrated, high tensile strength materials for the fusible elements and assembling parts by crimping (not soldering) which assures uniform accuracy, greater strength and permits closer fuse coordination accuracy. Available in standard ratings from 1 to 100 amperes. Comply with all NEMA standards.

Individual Fuse Link protected by paper tube and packed 25 in telescoping container.

Write for Bulletin 533

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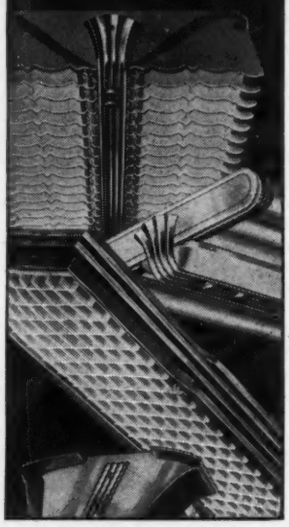
Smart styling

The key to SMITHCRAFT'S leadership in fluorescent lighting

"Distinctive and original in design," is the phrase many lighting authorities use in speaking of the Smithcraft line. Outstanding fluorescent fixtures start on the drawing boards of Smithcraft designers who keep an eye on tomorrow, while planning for today. For every factory, office and workroom there is a beautiful, efficient and appropriate Smithcraft unit.

A complete line of commercial and industrial fluorescent fixtures



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1500 WALNUT ST., PHILA. 2, PA.

Sales Opportunities

PENNSYLVANIA—Scott Paper Co., Chester, plans addition to power plant at local mill, with installation of equipment for increased capacity. This will be part of a general expansion program at Chester mill and branch plant at Fort Edward, N. Y., operated in name of Marinette Paper Co., a subsidiary interest. Additional buildings are planned, with machinery and electrical equipment for considerable increase in present output. No official estimate of cost announced. Financing is being arranged.

MINNESOTA—Town Council, Benson, is considering a report prepared by Pfeifer & Shultz, Wesley Temple Bldg., Minneapolis, Minn., consulting engineers, covering extensions and improvements in municipal steam-electric generating station, with installation of additional equipment for increased capacity. No estimate of cost announced. Authority to proceed with program is expected to be given soon.

TENNESSEE—Town Council, Clarksville, plans early call for bids for installation of new street-lighting system in downtown district. Cost estimated close to $100,000. John T. Cunningham, Jr., town engineer, in charge.

TEXAS—E. I. duPont deNemours & Co., Grasselli Chemicals Division, La Port, near Houston, plans expansion in local plant, comprising several new one and multi-story buildings, with machinery and electrical equipment for large increased output. Cost reported about $2,000,000. Proposed to begin work soon. Main offices are in duPont Bldg., Wilmington, Del.

WISCONSIN—Wisconsin Electric Power Co., Milwaukee, plans new power substation in vicinity of West Walnut and North Palmer Sts., to cost close to $300,000, with transformers, switchgear and auxiliary equipment. Also will construct new power substations at Racine and Town of Lake (Milwaukee County), and in vicinity of Hartland, reported to cost approximately $530,000. This is part of an expansion program in distribution systems in these areas, to include new lines and other operating facilities, complete project to represent investment of about $1,900,000.

CALIFORNIA—City Council, City Hall, Pasadena, will receive bids until April 22 (postponed from March 4) for two steam-generating units and auxiliary equipment, rating 250,000 lb. steam per hr., for installation in municipal power station at Glenarm St. and Raymond Ave.; and alternate bids for furnishing tubular-type preheaters in place of regenerative-type for boilers noted, all as per plans and specifications on file (Specifications L-D 45-34).

IOWA—Link Belt Speeder Corp., 1201 Sixth St., S.W., Cedar Rapids, has plans maturing for new one-story addition, with two-story section for auxiliary service, and modernization and improvements in several existing structures, including machinery and electrical equipment for large increased capacity. Cost estimated close to $1,000,000. Milton S. Carstens, 1 North LaSalle St., Chicago, Ill., is architect. Company is a subsidiary of Link Belt Co., Chicago.

TEXAS—Water and Light Dept., Brownsville, plans extensions and improvements in municipal steam-electric generating station, with installation of equipment for increased capacity. Cost estimated close to $275,000.

MARYLAND—Eastern Shore Public Service Co. of Maryland, plans addition to local generating station, and proposes to begin work on steel frame superstructure soon.

ILLINOIS—Illinois Power Co., Decatur, plans extensions in primary and secondary lines for rural electric service in parts of Marion, Fayette, St. Clair and other counties, totaling over 50 miles.

INDIANA—Board of Public Works, City Hall, Logansport, has authorized surveys and plans for alterations and extensions in municipal electrical distribution system, with primary circuits to be changed from three-wire, 2,300-volt, to four-wire, 4,160 volts. Estimates of cost will be made at once. Clement Smith, City Hall, is city engineer, in charge.

NEW YORK—Todd Shipyards Corp., 1 Broadway, New York, plans new four-story machine shop on site about 100 by 225 ft., at 627-45 West 42nd St., near ferry slips of West Shore Railroad, North River, where site has been acquired, with machinery, tools and electrical equipment for large capacity. Cost reported close to $750,000.

WYOMING—Bureau of Reclamation, Denver, Colo., will receive bids until April 15 for four 5,000-kva., three-winding, single-phase, 60-cycle, oil-immersed, outdoor-type transformers; two 7,500-kva., three-phase, 60-cycle, oil-immersed, outdoor-type auto-transformers; three single-pole, outdoor, autovalve, station-type lightning arresters, suitable for use on 115,000-volt, three-phase, ungrounded-neutral circuit; six similar lightning arresters, suitable for use on 69,000-volt circuit; one similar lightning arrester for 79,000-volt line service; and one similar lightning arrester for 57,000-volt line service, all for installation in power substation at Casper. Two 500-kva., single-phase, 60-cycle, oil-immersed, self-cooled, outdoor-type transformers; one 115,000-volt, three-pole, single-throw, manually gang-operated, outdoor-type disconnecting switch; three 115,000-volt, single-pole, hook-operated, outdoor-type, expulsion fuse disconnecting switches; three single-pole autovalve, outdoor station-type lightning arresters, for use on 115,000-volt circuit, all for installation in power substation at Alcova. One 115,000-volt, three-pole, single-throw, outdoor-type oil circuit breaker; two 115,000-volt, three-pole, manually gang-operated, outdoor-type disconnecting switches, all for power station at Seminoe. Substations noted are part of Kendrick project; all equipment will be installed by government (Specifications 1246).

INDIANA—Board of Public Works, City Hall, Jasper, will receive bids until April 16 for extensions and improvements in municipal steam-electric power plant, including installation of 5,000-kw. turbine-generator unit; surface-type condenser; two horizontal dual motor-driven circulating water pumps, each with rating of 6,000 gal. per min., and alternate bids on one such pump with rating of 10,000 gal. per min.; two motor-driven centrifugal pumps, each with rating of 186 gal. per min., complete with accessories; 10,000-gal. cooling tower; four or more motor-driven induced draft fans, each using 30-hp. motor; indoor-type, heavy-duty metalclad switchgear, switchboard and accessories. Bevington, Taggart & Fowler, Inc., Indiana Pythian Bldg., Indianapolis, is consulting engineer.

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RANDOLPH TRIGGER-TOUCH EXTINGUISHERS!

In fighting fires, it's ACTION that counts! With Randolph "4" it's action you get . . . *easy, quick* and *effective.*

Just one hand snaps this extinguisher from its bracket . . . one trigger-touch sends clouds of penetrating carbon dioxide into the blaze—smothers the fire in *split-seconds!* With no valves or nozzles to adjust, Randolph extinguishers eliminate panic—get the employee to the blaze *before* it spreads!

A dry, non-toxic gas, carbon dioxide does not damage equipment or conduct electricity. It leaves no stain or liquid to clean up. And here's a fire-fighting agent that can't freeze or deteriorate . . . ends constant refilling and repairs.

Check up on your flammable liquid and electrical hazards . . . mobilize against fire with Randolph "4", "10", "15" and "25" fast-action extinguishers. To get the complete fire protection facts, simply tear out the coupon below, or write us—today!

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Please send me your FREE fire protection handbook "How To Fight Fires With Carbon Dioxide" Also rush details on new carbon dioxide fire extinguishers.

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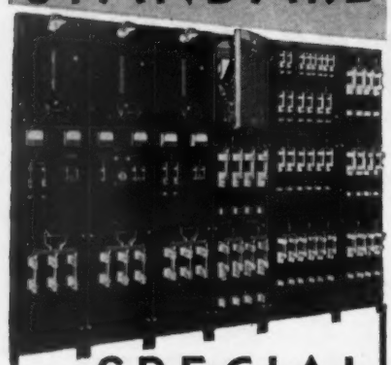
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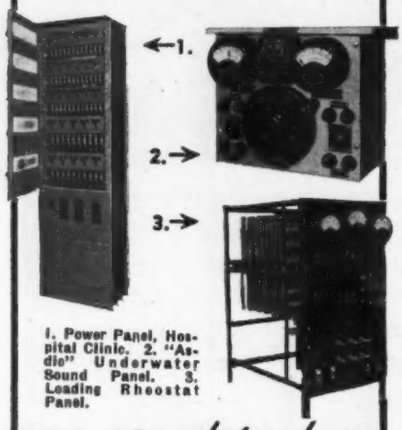

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Standardized units are recommended when they fit your requirements in every detail. Certain types of switchboards and panels enable us to give you the economies of quantity production.

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UNEXCELLED QUALITY

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Recent Rate Changes

ILLINOIS COMMERCE COMMISSION has ordered an immediate reduction, amounting to approximately $6,000,000 annually, in electric light and power rates charged by the Commonwealth Edison Co., the Public Service Co. of Northern Illinois, Western United Gas & Electric Co. and the Illinois Northern Illinois Utilities Co. Approximately 1,394,000 customers will benefit from the reduction. The commission has also ordered a simplified system of computing rates for home users, eliminating the old rate system based upon the number of rooms in the dwelling. Estimated yearly rate savings to customers of individual companies are: Commonwealth Edison, $3,440,900; Public Service Co. of Northern Illinois, $1,838,000; Western United Gas & Electric, $261,000, and Illinois Northern Utilities, $327,000. The new rates for all residences will be 5 cents per kilowatt-hour for each of the first 25 kw.-hr.; 3 cents per kilowatt-hour for the next 75 kw.-hr. and 2 cents per kilowatt-hour for all over 100. John D. Biggs, chairman of the commission, stated that the reduction had been under way since V-J Day, and that the companies accepted the reductions without reservations. "By their willingness to agree to a reduction under current conditions, the companies indicate their confidence in the economic future of the areas they serve."

UNION ELECTRIC CO., St. Louis, Mo., has announced a proposed rate reduction of $835,000 per year, affecting 357,000 customers in St. Louis and 156 other Missouri, Illinois and Iowa communities. In schedules to be filed with the state Public Service Commission and Illinois Commerce Commission on March 29, the company also proposes to simplify the rate structure of the system. New rates if approved will be applied to all bills rendered on and after May 1. Two will be established, one for urban zone customers and one for rural users, to replace eight different rate schedules now applicable in various territories. Free lamp renewals will be eliminated coincidentally with this change. Heavy reductions in the selling price of lamp bulbs in recent years, coupled with the fact that less than 25 percent of Union Electric customers availed themselves of the privilege, led to this decision. All of the saving to the company from this change, it was stated, has been included in the proposed reduction in rates, actually about 10 percent of the total amount.

NORTHERN STATES POWER CO. has announced a general rate reduction which will cut $2,500,000 from bills throughout the area served by the company. Electric power consumers in Minneapolis will benefit to the amount of $785,000 annually and St. Paul customers $420,000. The new rates for the Twin Cities will become effective April 1. A rate reduction for Wisconsin consumers will result in a $318,000 annual saving. Under the new rate structure, the top residential rate will drop from 5 cents to 4 cents per kilowatt-hour for the first 50 kw.-hr. The prompt payment discount will make the new rate 3.8 cents. An average saving of 24 cents on residential bills after the first 25 kw.-hr. will be realized.

INDIANAPOLIS POWER & LIGHT CO. has instituted a voluntary reduction in rates which, it is estimated, will save electric power consumers in Indianapolis and vicinity approximately $750,000 annually. The action was announced by Sam Busby, secretary of the state Public Service Commission, after a petition had been filed with the commission by the utility. The reduced schedule will become effective on bills rendered on and after June 1, but the saving to individual users has not yet been computed. A schedule now is being worked out between the commission and the company. H. T. Pritchard, company president, said the reductions are being worked out with the commission "as a way of giving the public some benefit from a federal tax reduction, even though a large part of such tax saving will be needed to cover increased operating costs." Rate cuts are being considered for 125,000 residential users, 17,000 commercial and 380 industrial customers, according to company officials.

CENTRAL ILLINOIS PUBLIC SERVICE CO. has been ordered by the State Commerce Commission to reduce its electric rates $496,000 annually. The reduction applies to 130,000 residential and 25,000 commercial customers in 514 cities, villages and towns in central and southern Illinois. Residential customers will receive an annual rate cut totaling $411,000 and the reduction for commercial customers will total $85,000. The average annual reduction will be $3 a year for residential electric users, the commission said. The new rates will become effective May 1.

NORTHERN INDIANA PUBLIC SERVICE CO. has announced a new schedule of rates effective May 1, which will save electric power and natural gas users approximately $550,000 annually. Under the new schedule, consumers will save annually approximately $339,000 on electric power each year. The savings will be on commercial, residential and block power rates. In addition, the company has advanced a proposal for new contracts on street lighting, also approved by the commission, in which cities will save $96,500 in their annual light bills.

CENTRAL NEW YORK POWER CORP. has filed with the New York Public Service Commission schedules representing a net reduction of $676,000 annually in its commercial and industrial electric rates, effective April 15. Nearly 25,000 commercial and industrial concerns in the territory served by the company will receive reductions under the new scale, while 3 percent will pay slightly more, the company stated. The reduction follows a $343,000 cut in residential and farm rates, which went into effect on January 1, making the total annual saving to consumers $1,019,000.

TIDE WATER POWER CO., Wilmington, N. C. will institute rate reductions estimated to save customers $103,000 annually. The new domestic rate in New Hanover County, will be $4 per hundred kilowatt-hours, a reduction of eleven cents, and for customers on the utilitity's "transmission system" outside the county it will be $4.20 a hundred, a reduction of 33 cents.

TEXAS ELECTRIC SERVICE CO. has reduced its electric rates approximately $635,000 annually for consumers in Fort Worth. Greatest reduction is in residential charges. Total annual savings for residential and commercial users is expected to amount to $1,142,000. Similar reductions announced for Wichita Falls, Tex., are expected to result in $117,700 less revenue for the company there.

WEST TEXAS UTILITIES CO. has announced residential rate reductions for 117 communities. In announcing the reduction, Price Campbell, president, said the other 57 communities served by the company will have reductions by May 1.

HOOD RIVER ELECTRIC COOPERATIVE, Hood River, Ore., has announced a 24 percent reduction in residential rates for electric con-

sumers in farm areas and 10 to 21 percent for residential service in the city of Hood River.

SOUTHWESTERN PUBLIC SERVICE CO.'s new rate reductions, totaling $6,050 annually for customers of the Pecos Valley Division, have been approved by the New Mexico Public Service Commission.

CONSOLIDATED EDISON CO.'s proposal for rate reductions, which are estimated to save consumers $6,500,000 annually, has been approved by the New York Public Service Commission. The rates, in effect for several months while hearings were conducted, will become officially effective on April 1. They were agreed on as a condition of the commission's consent to the merging of Brooklyn Edison Co. and New York & Queens Electric Light & Power Co. into Consolidated, their parent organization.

SOUTH CAROLINA PUBLIC SERVICE AUTHORITY (Santee-Cooper) has announced new reduced electric power rates for its Horry and Berkeley county customers, effective March 30. The new rates will result in a customer saving of approximately $83,000 a year.

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Recent Legislation

NEW YORK—Action on several bills affecting the electric utility industry was taken recently in Albany. The Assembly passed, 81 to 44, the Lawrence bill prohibiting the construction of new or additional regulating reservoirs in the Adirondack park. The bill goes to the Senate. The Senate has passed and sent to the Assembly the Wicks bills, amending Paragraph 73-a, Public Health Law. The amendment provides sanitary control of New York City water supply board shall not extend beyond sources of potable water supply tributary to Delaware aqueduct and that water supply, gas and electricity commissioner and water supply board shall not have or exercise concurrent powers or sanitary control over any source of potable water supply tributary to such aqueduct. A bill has been introduced in the Legislature, amending the Constitution, relative to municipal debt limit and electric system. The measure provides in ascertaining municipal debt limit, there shall be excluded debts for acquiring private electric system or for establishing municipal electric system for the operating municipality and its inhabitants. The Assembly has passed and sent to the Senate the Dwyer bill, amending New York City Administrative Code to authorize New York City water supply board, subject to approval of estimate board, to permit use of water for generation and sale of electric energy by corporation which was owner of water power site affected, acquired or damaged by plan for additional city water supply; lease may be for not to exceed 50 year period.

VIRGINIA—House finance committee, by a vote of 10 to 5, killed the Spiers Bill, increasing from ½ of 1 percent to 1 percent of gross receipts the local license tax upon water, heat and power companies.

•

Opens Rochester Office

Brown Instrument Co. division of Minneapolis-Honeywell Regulator Co. has opened a sales and service office at 16 State St., Rochester, N. Y., under the supervision of Gerald L. Britton.

G-E PYREX* PLUG FUSES

FOR BRANCH CIRCUIT PROTECTION

(3-30 Amp., 125 Volts)

USE these high quality plug fuses everywhere for branch circuit protection. Use them for replacements of all kinds. G-E Pyrex fuses are sturdy and will give lasting protection. *The Pyrex top* is one piece and heat resistant. *The base* is cold molded and keyed into the Pyrex top. There is little chance of its turning and damaging the link. *The shell* holding the Pyrex top and the base together is staked securely into the base. This construction provides strength in the fuse.

G-E Pyrex fuses are easy to use and have an insulated grip. Ratings can be read at two points: on the fuse link seen through a magnifying lens window and on the contact rivet at the base of the fuse. These fuses are packed in handy fuse dispenser cartons—five fuses to a carton.

For further information see the nearest G-E Merchandise Distributor or mail the coupon for a G-E Fuse Catalog. This catalog gives full details on G-E Pyrex Fuses and on other G-E Fuses.

General Electric Company

Section D-366-9, Appliance and Merchandise Dept.,

Bridgeport, Connecticut

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